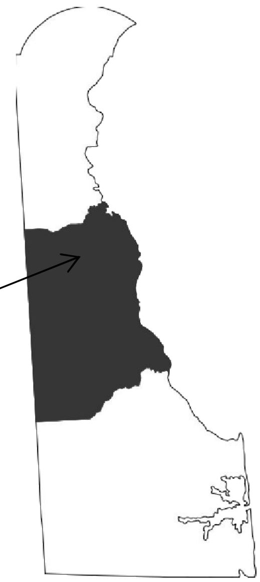
FLOOD INSURANCE STUDY

VOLUME 1 OF 2

KENT COUNTY, DELAWARE
AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
BOWERS, TOWN OF	100002
CAMDEN, TOWN OF	100003
CHESWOLD, TOWN OF	100004
CLAYTON, TOWN OF	100005
DOVER, CITY OF	100006
FARMINGTON, TOWN OF*	100061
FELTON, TOWN OF	100008
FREDERICA, TOWN OF	100009
HARRINGTON, CITY OF	100010
HARTLY, TOWN OF*	100063
HOUSTON, TOWN OF*	100064
KENT COUNTY (UNINCORPORATED AREAS)	100001
KENTON, TOWN OF*	100013
LEIPSIC, TOWN OF	100014
LITTLE CREEK, TOWN OF	100015
MAGNOLIA, TOWN OF*	100065
SMYRNA, TOWN OF	100017
VIOLA, TOWN OF*	100069
WOODSIDE, TOWN OF	100070
WYOMING, TOWN OF	100020

*No Special Flood Hazard Areas Identified

PRELIMINARY
FEB 15 2016

REVISED DATE:

TBD

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
10001CV001C

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: May 5, 2003

First Revised Countywide FIS Effective Date - July 7, 2014: To incorporate new detailed coastal flood hazard analyses, to add Base Flood Elevations and Special Flood Hazard Areas; to change zone designations and Special Flood Hazard Areas; to update roads, road names, and corporate limits; to incorporate previously issued Letters of Map Revision; to modify Coastal Barrier Resource Areas and Otherwise Protected Areas; and to reflect updated topographic information.

Second Revised Countywide FIS Effective Date - TBD: To update effective approximate flood hazard analysis; to add Base Flood Elevations; to change zone designation and Special Flood Hazard Areas; and to reflect updated topographic information.

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FLOOD INSURANCE STUDY
KENT COUNTY, DELAWARE AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Kent County, Delaware, including: the unincorporated areas of Kent County; the Cities of Dover and Harrington; and the Towns of Bowers, Camden, Cheswold, Clayton, Farmington, Felton, Frederica, Hartly, Houston, Kenton, Leipsic, Little Creek, Magnolia, Smyrna, Viola, Woodside, and Wyoming (hereinafter referred to collectively as Kent County); and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Towns of Clayton and Smyrna are geographically located in Kent and New Castle Counties. The Towns of Clayton and Smyrna are included in their entirety in this FIS report. The City of Milford is geographically located in Kent and Sussex Counties. The City of Milford is shown in its entirety in the FIS report for Sussex County. See the separately published FIS reports and Flood Insurance Rate Maps (FIRMs) for countywide map dates and flood hazard information outside of Kent County.

Please note that on the effective date of this study, the Towns of Farmington, Hartly, Houston, Kenton, Magnolia, and Viola have no mapped Special Flood Hazard Areas (SFHAs). This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e. annexation of new lands) or the availability of new scientific or technical data about flood hazards.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The original May 5, 2003 countywide FIS was prepared to include all jurisdictions within Kent County into a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction with a previously printed FIS report included in the countywide FIS is shown below.

Bowers, Town of:	The wave heights analysis for the FIS report dated March 2, 1982, were performed by Dewberry & Davis for the Federal Emergency Management Agency (FEMA). That work covered coastal flooding from Delaware Bay.
Camden, Town of:	The hydrologic and hydraulic analyses for the FIS report dated March 16, 1981, were prepared by Edward H. Richardson Associates, Inc., for the Federal Insurance Administration (FIA), under contract No. H-4597. That work was completed in April 1979.
Clayton, Town of:	The hydrologic and hydraulic analyses for the FIS report dated December 1976 were performed by Greenhorne & O'Mara, Inc., for the FIA, under contract No. H-3689. That work, which was completed in May 1976, covered all flooding sources affecting the Town of Clayton.
Dover, City of:	The hydrologic and hydraulic analyses for the FIS report dated March 16, 1982, were prepared by Edward H. Richardson Associates, Inc., for FEMA under Contract No. H-4597. That work was completed in April 1979.
Frederica, Town of:	The hydrologic and hydraulic analyses for the FIS report dated July 2, 1980, were prepared by Kidde Consultants, Inc., for the FIA under Contract No. H-4745. That work was completed in September 1979.
Harrington, City of:	The hydrologic and hydraulic analyses for the FIS report dated December 1976, were performed by Greenhorne & O'Mara, Inc., Consulting Engineers, Riverdale, Maryland, for the FIA, under Contract No. H-3689. That work was completed in May 1976, covering all flooding sources affecting the City of Harrington.
Kent County, (Unincorporated Areas):	The hydrologic and hydraulic analyses for the FIS report dated May 1976 were performed by Greenhorne & O'Mara, Inc., for the FIA, under

Contract No. H-3689. That work, which was completed in August 1975, covered all significant flooding sources affecting the unincorporated areas of Kent County, Delaware. The Wave Height Analysis Supplement was added to the study to cover coastal effects from Delaware Bay.

Leipsic, Town of:	The hydrologic and hydraulic analyses for the FIS report dated March 1978, were prepared by the U.S. Soil Conservation Service (now the Natural Resources Conservation Service [NRCS]), for the FIA under Inter-Agency Agreement No. IAA-H-8-77, Project Order No. 5. That work was completed in July 1977, and covered all significant flooding sources affecting the Town of Leipsic, Delaware.
Little Creek, Town of:	The hydrologic and hydraulic analyses for the FIS report dated July 1978, were prepared by the NRCS for the FIA under Inter-Agency Agreement No. IAA-H-8-77, Project Order No. 5. That work, which was completed in June 1977, covered all significant flooding sources affecting the Town of Little Creek, Delaware.
Smyrna, Town of:	The hydrologic and hydraulic analyses for the FIS report dated December 1976, were prepared by Greenhorne & O'Mara, Inc., for the FIA under Contract No. H-3689. That work was completed in May 1976, and covered all flooding sources affecting the Town of Smyrna.
Wyoming, Town of:	The hydrologic and hydraulic analyses for the FIS report dated September 16, 1980, were prepared by Edward H. Richardson Associates, Inc., for the FIA under Contract No. H-4597. That work was completed in April 1979.

The authority and acknowledgements for the Towns of Cheswold, Felton, and Woodside are not available because no FIS reports were published for these communities.

There are no previous FISs or FIRMs for the Towns of Farmington, Hartly, Houston, Kenton, Magnolia, and Viola; therefore, the previous authority and acknowledgments for these communities are not included in this FIS. These communities will not appear in Table 13, "Community Map History" (Section 6.0).

For the May 5, 2003 countywide FIS, the hydrologic and hydraulic analyses for the riverine flooding sources were prepared by the U.S. Army Corps of Engineers (USACE), Philadelphia District, for FEMA, under Inter-Agency Agreement No. EMW-97-IA-0140, Project Order No.4. This work was completed in September 2000.

The riverine hydrologic and hydraulic analyses for the July 7, 2014 revision were performed by URS Corporation, for the Delaware Department of Natural Resources and Environmental Control (DNREC), under Task Order No. 07010106714. The coastal analyses for the July 7, 2014 revision were performed by Risk Assessment Mapping and Planning Partners (RAMPP) under contract No. HSFEHQ-09-D-0369, Task Order HSFE03-09-0002. The final FIRM database for the July 7, 2014 revision was developed by RAMPP under contract No. HSFEHQ-09-D-0369, Task Order HSFE03-09-0002 for the coastal floodplain portion and Task Order HSFE03-09-0003 for the riverine floodplain portion. The study was completed in August 2012.

The riverine hydrologic and hydraulic analyses for this revision were performed by AECOM, for the Delaware Department of Natural Resources and Environmental Control (DNREC), under Purchase Order No. STATE-0000206219.

Base map information for political boundaries shown on this FIRM was provided in digital format by Kent County in 2013. Road centerlines were downloaded from the Delaware Geospatial Data Exchange in 2012.

The coordinate system used for the production of this FIRM is Delaware State Plane (FIPS Zone 0700), with a Lambert Conformal Conic projection, units in feet. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the North American Datum of 1983, GRS80 spheroid. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of the information shown on the FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of an FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with the same representatives to review the results of the study.

The dates of the initial and final CCO meetings held for the incorporated communities within Kent County are shown in Table 1, "Initial and Final CCO Meetings."

TABLE 1 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial/Intermediate CCO Meeting(s)	Final CCO Meeting(s)
Bowers, Town of	*	*
Camden, Town of	June and July of 1977	May 8, 1980
Clayton, Town of	November 1975	May 26, 1976
Dover, City of	July 1977	August 11, 1981
Frederica, Town of	April 2, 1978	February 13, 1980
Harrington, City of	November 1975	May 27, 1976
Kent County (Unincorporated Areas)	September 13, 1974	July 1, 1975
Leipsic, Town of	August 18, 1976	*
Little Creek, Town of	August 18, 1976	February 6, 1978
Smyrna, Town of	November 1975	May 26, 1976
Wyoming, Town of	June and July of 1977	May 8, 1980

*Data not available

For the May 5, 2003 countywide FIS, an initial CCO meeting was held July 19, 1996, and was attended by representatives from the Towns of Clayton and Smyrna; and the Cities of Dover and Harrington; Kent County Emergency Planning and Operations; (USACE); FEMA; Delaware Emergency Management Agency (DEMA); and the Department of Natural Resources and Environmental Control.

The results of the study were reviewed at the final CCO meeting held on December 3, 2001 and attended by representatives from the Towns of Clayton, Smyrna, and Little Creek; and the Cities of Dover and Harrington; Kent County Emergency Planning and Operations; Dewberry & Davis LLC; the USACE; FEMA; DEMA; and DNREC.

For the July 7, 2014 revision, an initial CCO meeting was held on December 1, 2010 in Dover, DE, and was attended by representatives of FEMA, RAMPP, Kent County, Town of Bowers, Delaware Emergency Management Agency; and the Department of Natural Resources and Environmental Control. A Flood Risk Review meeting was also held on July 31, 2012 for the coastal study and was attended by representatives of FEMA, RAMPP, Kent County, Town of Bowers, City of Dover, Delaware Emergency Management Agency; and DNREC. A final CCO meeting was held on October 22, 2012 and was attended by representatives of FEMA; USACE; RAMPP; Kent County; Cities of Dover and Harrington; Towns of Bowers, Camden, Felton, and Leipsic; DEMA; and DNREC.

For this revision, an initial CCO meeting was held on June 23, 2015, and was attended by representatives of Kent County, DNREC, and AECOM.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Kent County, Delaware.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Andrews Lake	Maidstone Branch
Beaverdam Ditch	Marshyhope Creek
Brown's Branch North	Marshyhope Ditch
Brown's Branch South	McColley Pond
Cahoon Branch	McGinnis Pond
Choptank River	Mill Creek
Coursey Pond	Morgan Branch
Cow Marsh Creek	Penrose Branch
Culbreth Marsh Ditch	Providence Creek
Delaware Bay	Puncheon Branch
Duck Creek	St. Jones River
Fork Branch	Stream No. 1
Green Branch	Tantrough Branch
Green's Branch	Tappahanna Ditch
Horsepen Arm	Tidbury Creek
Isaac Branch	Tidy Island Creek
Leipsic River	Willow Grove Prong
Little River	Wyoming Lake

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through Kent County.

For this revision and for the July 7, 2014 revision, limited detailed analyses were performed for the flooding sources shown in Table 3, "Scope of Revision."

TABLE 3 - SCOPE OF REVISION

Stream Name	Limits of Limited Detailed Study
Beaverdam Branch[1]	From the confluence with Murderkill River to a point approximately .62 mile upstream of Marshyhope Road
Beaverdam Branch Trib 1[1]	From the confluence with Beaverdam Branch to a point approximately .26 mile upstream of confluence with Beaverdam Branch
Black Arm Branch[2]	From the confluence with Black Arm Branch Prong 4 to approximately 0.24 mile upstream of Hills Market Road
Black Arm Branch Prong 4[2]	From the confluence with Black Arm Branch to approximately 0.3 mile upstream of Park Brown Road
Black Arm Branch Prong 5[2]	From the confluence with Black Arm Branch to approximately 0.8 mile upstream of the confluence with Black Arm Branch
Black Swamp Creek[1]	From the confluence with Murderkill River to a point approximately 1.34 miles upstream of Hopkins Cemetery Road
Bright Haines Branch[2]	From the confluence with Marshyhope Creek to the confluence of Bright Haines Branch Harrington Prong
Bright Haines Branch Farmington Prong[2]	From the confluence of Bright Haines Branch Harrington Prong to approximately 0.4 mile upstream of Gingerwood Drive
Bright Haines Branch Farmington Prong Prong 5[2]	From the confluence with Bright Haines Branch Farmington Prong to approximately 0.4 mile upstream of confluence with Bright Haines Branch Farmington Prong Prong 5 Tributary 2
Bright Haines Branch Farmington Prong Prong 5 Tributary 2[2]	From the confluence with Bright Haines Branch Farmington Prong Prong 5 to approximately 940 feet upstream of the confluence with Bright Haines Branch Prong Prong 5
Bright Haines Branch Farmington Prong Prong 10[2]	From the confluence with Bright Haines Branch Farmington Prong to approximately 0.2 mile upstream of Flat Iron Road

TABLE 3 - SCOPE OF REVISION - Continued

Stream Name	Limits of Limited Detailed Study
Bright Haines Branch Harrington Prong[2]	From the confluence with Bright Haines Branch to approximately 1.0 mile upstream of the confluence of Bright Haines Branch Harrington Prong Prong 8
Bright Haines Branch Harrington Prong Prong 7[2]	From the confluence with Bright Haines Branch Harrington Prong to approximately 0.7 mile upstream of the confluence with Bright Haines Branch Harrington Prong
Bright Haines Branch Harrington Prong Prong 8[2]	From the confluence with Bright Haines Branch Harrington Prong to approximately 0.6 mile upstream of the confluence with Bright Haines Branch Harrington Prong
Browns Branch[1]	From approximately .1 mile downstream of Sandbox Road to approximately 1.15 miles upstream of Doctor Smith Road
Browns Branch Branch Trib 1[1]	From the confluence with Browns Branch to approximately 510 feet upstream of Delaware Avenue
Brownsville Branch[2]	From the confluence with Horsepen Arm Branch to approximately 0.7 mile upstream of Brownsville Road
Cat Tail Branch[2]	From the confluence with Black Arm Branch to approximately 1.0 mile upstream of High Stump Road
Cat Tail Branch Prong 8[2]	From the confluence with Cat Tail Branch to approximately 770 feet upstream of High Stump Road
Double Run[1]	From approximately .55 mile downstream of Irish Hill Road to approximately 200 feet upstream of Barney Jenkins Road
Fan Branch[1]	From the confluence with Murderkill River to approximately 238 feet upstream of State Highway 12
Grambull Branch[2]	From the confluence with Ingram Branch to approximately 0.5 mile upstream of the confluence with Ingram Branch

TABLE 3 - SCOPE OF REVISION - Continued

Stream Name	Limits of Limited Detailed Study
Green Branch[2]	From the confluence with Black Arm Branch to approximately 0.5 mile upstream of Pear Tree Lane
Green Branch Prong 17[2]	From the confluence with Green Branch to approximately 380 feet upstream of Concord Road
Green Branch Prong 17 Tributary 1[2]	From the confluence with Green Branch Prong 17 to approximately 120 feet upstream of Shortly Road
Green Branch Prong 20[2]	From the confluence with Green Branch to approximately 0.9 mile upstream of the confluence with Green Branch
Horsepen Arm [2]	From the confluence with Black Arm Branch to approximately 1.2 miles upstream of the confluence with Horsepen Arm Branch Prong 11
Horsepen Arm Branch Prong 4[2]	From the confluence with Horsepen Arm to approximately 820 feet upstream of Park Brown Road
Hudson Branch[1]	From just downstream of Fox Chase Road to approximately 1.34 miles upstream of Turkey Point Road
Ingram Branch[2]	From approximately 0.5 mile downstream of Ingram Branch Road to approximately 460 feet upstream of Whiteleysburg Road
Ingram Branch Prong 2[2]	From the confluence with Ingram Branch to approximately 0.5 mile upstream of Whiteleysburg Road
Murderkill River[1]	From just downstream of Killens Pond Road to approximately .74 mile upstream of Marshyhope Road
Point Branch Main[2]	From the confluence with Prospect Branch to approximately 0.9 mile upstream of Prospect Church Road
Pratt Branch[1]	From approximately .35 mile downstream of Andrews Lake Road to just downstream of US Highway 13
Prospect Branch[2]	From the confluence with Bright Haines Branch to 0.6 mile upstream of Hemping Road

TABLE 3 - SCOPE OF REVISION - Continued

Stream Name	Limits of Limited Detailed Study
Quarter Branch[2]	Approximately 0.6 mile downstream of Todds Chapel Road to approximately 0.6 mile upstream of the confluence of Quarter Branch Prong 3
Quarter Branch Prong 3[2]	From the confluence with Quarter Branch to approximately 0.6 mile upstream of the confluence with Quarter Branch
Saulsbury Creek[2]	From the confluence with Cat Tail Branch to approximately 120feet upstream of the confluence with Saulsbury Creek Prong 8
Saulsbury Creek Prong 2[2]	From the confluence with Saulsbury Creek to approximately 0.3 mile upstream of the confluence with Saulsbury Creek Prong 2 Tributary 3
Saulsbury Creek Prong 2 Tributary 2[2]	From the confluence with Saulsbury Creek Prong 2 to approximately 0.5 mile upstream of the confluence with Saulsbury Creek Prong 2
Saulsbury Creek Prong 2 Tributary 3[2]	From the confluence with Saulsbury Creek Prong 2 to approximately 0.5 mile upstream of the confluence with Saulsbury Creek Prong 2
Saulsbury Creek Prong 3[2]	From the confluence with Saulsbury Creek to approximately 0.4 mile upstream of Cattail Branch Road
Saulsbury Creek Prong 8[2]	From the confluence with Saulsbury Creek to approximately 0.2 mile upstream of the confluence with Saulsbury Creek
Saulsbury Creek Prong 9[2]	From the confluence with Saulsbury Creek to approximately 0.1 miles upstream of the confluence with Saulsbury Creek
Spring Branch[1]	From approximately .60 mile downstream of Scrap Traven Road to just upstream of Dupont Highway
Tomahawk Branch[2]	From the confluence with Marshyhope Creek to approximately 0.7 mile upstream of Greenwood Road

[1]July 7, 2014 revision
[2]This revision

The July 7, 2014 revision also incorporated new detailed coastal flood hazard analyses for Delaware Bay.

The July 7, 2014 revision also incorporated the determination of three Letters of Map Revision (LOMR): case number 07-03-0676P, dated April 26, 2007 issued for Garrison Lake; case number 08-03-0106P, dated November 30, 2007 issued for Delaware Bay; and case number 10-03-0303P, dated June 27, 2011 issued for Tidbury Creek and Red House Branch.

During this revision, all or portions of numerous flooding sources in the county were studied by approximate methods. In addition, 1- percent annual chance floodplains for some of the previously studied flooding sources were redelineated based on updated topographic data.

2.2 Community Description

Kent County is the middle county of three counties in the State of Delaware. The county is bordered on the north by New Castle County, on the south by Sussex County, on the east by Delaware Bay, and on the west by the State of Maryland. According to the U.S. Census Bureau, the population of Kent County was estimated to be 164,834 in 2011 (US. Census Bureau, 2011).

The temperature range is moderate, varying from an average low of 27 degrees Fahrenheit (°F) in February to an average high of 89°F in July. Due to the relatively small size of the county, 594 square miles, and the flat topography, the weather conditions are uniform throughout the county. The average annual rainfall is 46 inches. Because this is a coastal state, the largest storms will be hurricanes and, therefore, much of the flooding that would occur will result from the accompanying high tides.

Kent County is part of the geological subdivision known as the Atlantic Coastal Plain Province. This is a formation of layered rock beds sloping gradually toward the Atlantic Ocean, arranged like a shingled roof. The entire formation is completely covered by a layer of ice-age sand and gravel residue. This covering provides a good to very good soil condition for vegetal growth. Consequently, much of the county is cultivated, productive farmland. Most of the remainder of the county is natural forest or wetland.

The topography of Kent County is basically flat, with elevations ranging from 0 foot mean sea level to a high of about 80 feet mean sea level. This low profile, coupled with poorly drained soils, produces a great deal of wetland, especially on the Bay Coast.

2.3 Principal Flood Problems

There are two primary areas of flooding in Kent County. The first is the Bay Shore Area and the second is the western half of the county. The Bay Shore Area is frequently subject to flooding due to high tides. However, monetary damage is usually minimal because most flooding occurs on the beaches and wetland, where there is little or no urban development. Some damage does occur due to the backwater effect of these high tides on the bay estuaries. Smyrna and Dover are subject to tidal effects.

The western half of the county is a very flat, poorly drained area and, consequently, is frequently subjected to temporary ponding of storm water. The damage resulting from this ponding is usually limited to crop damage, because the area is primarily rural with very little urban development.

The two most severe types of storms experienced in the tidal areas of Kent County include hurricanes and nor'easters. While sketchy accounts exist for storms that occurred before 1923, records for the 1923-1977 era are more complete. The following are excerpts detailed recent storms causing damage within Kent County (Delaware Coastal Management Program, 1977; Federal Insurance Administration, 1976).

February 19-20, 1927

At Bowers Beach, 2.5 feet of sand was eroded from the beach. The seas at the height of the storm reached 20 feet. All the cottages built of floats were washed into the marshes.

August 22-23, 1933

Seawater traveling inland between Kitts Hummock and Lewes destroyed crops. People had to be removed from second-story windows in Kitts Hummock. Fort Saulsbury north of Slaughter Beach was flooded and Bowers Beach was completely under water.

April 27, 1937

Delaware Bay resorts suffered more than those on the oceanfront. Bowers Beach was under water as waters washed far inland past the town and residents of the low sections of Bowers Beach took refuge in a general store in the higher, northernmost end of town.

November 25-26, 1950

This storm was termed "the worst storm since 1912." At Kitts Hummock water entered nearly every cottage. Flood waters were reported as far inland as one mile. Damage was estimated at $25,000. At Bowers Beach the high water mark recorded at Paskeu's Wharf was 7.6 feet.

The storm brought severe damage to Pickering Beach, a summer resort less than one year old. Damage to cottages along the beach was estimated at between $10,000 and $15,000, a figure which does not include the loss of the sand beach. The beach was entirely washed away.

<u>March 1962</u>

Bowers Beach was the hardest hit Kent County community. In addition to flooding some homes were washed 500 yards inland; others were ripped from their foundations. A high water mark recorded at Paskeu's Wharf was 7.6 feet. Kitts Hummock-Battered by tides, with some homes washed from their foundations. Woodland Beach - Flooded, but homes not as badly damaged as in other communities because land is generally higher and wave fetch is very short.

<u>August 1967</u>

Flood damage in Delaware was estimated at $200,000. Most of the damage occurred in Kent County, which was hardest hit by the storm. Statewide, approximately four dams and 36 bridges and culverts were washed out or badly damaged. At least three persons died in Kent County as a result of this flood.

<u>November 11-12-12, 1968</u>

Nor’easter- Gale force winds and flooding were accompanied by four-foot tides. The areas most affected were Woodland Beach, Big Stone Beach, and Bowers Beach. Fifty people evacuated from Bowers Beach.

<u>December 1, 1974</u>

Nor’easter- East and northeast winds up to 80 miles per hour driving 10- to 12-foot storm waves caused significant beach erosion and moderate flooding. The Delaware coast was fortunate that the brunt of the storm occurred at low tide. Pickering Beach suffered significant damage from this storm.

Significant damage to the dune line occurred at Big Stone Beach, Bowers Beach, and Kitts Hummock, while residents from Pickering Beach, Bowers Beach, and Kitts Hummock had to be evacuated.

2.4 Flood Protection Measures

Along the western edge of the county, there are tax ditch programs designed to promote more efficient land drainage. This is primarily for the benefit of the farms in that area. These tax ditch programs are intended to curtail the crop damage due to the storm water ponding and to drain other land that has been previously unusable due to the poor drainage.

Along the eastern edge of the county, a regulatory body known as the Delaware Coastal Zone Planning and Regulatory Administration is in effect. The primary purpose of this body is to protect against the natural state of the coastline by regulating industrial growth and expansion in that region. Although not specifically a flood protection program, it does tend to prevent commercial and residential tidal flood damage by regulating the construction of industrial facilities and residential developments in the flood prone areas.

In the City of Dover, the dam at Silver Lake has some flood peak attenuation effects from upland runoff and also may serve as a barrier to tidal incursion above that point. Some residents have limited areas of floodplain fill.

In the Town of Frederica, there are no manmade flood protection structures along the Murderkill River. The river does, however, go through several oxbows on its way to the Delaware Bay. These oxbows tend to damper waves that attempt to traverse the watercourse from the bay.

In the Town of Smyrna, the Lake Como Dam on Mill Creek acts as the upper limit to the tidal influence of Delaware Bay.

Flood protection measures in Harrington include channel realignment, occasional channel maintenance, and flood control/drainage projects designed by the NRCS. On Brown's Branch North, there was channel realignment, replacement of inadequate hydraulic structures, and bank stabilization. However, lack of proper maintenance has caused a decrease in the flood control benefits to be derived from the NRCS project. Other flood protection measures include land treatment practices, such as tax ditches, and land conservation techniques.

FEMA specifies that all levees must have a minimum of 3 foot freeboard against 1- percent annual chance flooding to be considered a safe flood protection structure.

Levees exist in the study area that provides the community with some degree of protection against flooding. However, it has been ascertained that these levees may not protect the community from rare events such as the 1- percent annual chance flood. The criteria used to evaluate protection against the 1- percent annual chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1- percent annual chance flood are not considered in the hydraulic analysis of the 1- percent annual chance floodplain.

There are several levees within Kent County and its incorporated areas. None of these levees provide protection against any flooding hazard.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 1-percent annual chance flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting Kent County.

Information on the methods used to determine peak discharge-frequency relationships for the streams studied by detailed methods is shown below.

Pre-countywide Analyses

For each community within Kent County that has a previously printed FIS report, the hydrologic analysis described in those reports has been compiled and is summarized below.

For Brown's Branch North, Brown's Branch South, Green's Branch, Isaac Branch, Leipsic River, Mill Creek, Puncheon Branch, Stream No. 1, Tantrough Branch and Tidbury Creek, the available rain gage and stream stage data is sparse. Consequently, due to the lack of data and short-term periods for the data that were available, a log-Pearson Type III Method (Water Resources Council, 1967) for determining the frequency discharges in the regions studied could not be properly used. The most accurate hydrology program available for the type of data supplied is the TR-20 program designed by the NRCS (U.S. Department of Agriculture, 1965). The rainstorms for the various recurrence intervals used to compute the peak discharges used in this program were taken from the U.S. Weather Bureau Technical Paper No. 40 (U.S. Weather Bureau, 1961). The TR-20 program was chosen due to the fact that the county is primarily rural and topographically uniform, which makes it well suited for the type of hydrologic methods used by the NRCS. The results of the program were tampered where necessary with good engineering judgment and experience in this field.

Several additional methods of analyses were used for Brown's Branch North and Brown's Branch South. A method relating peak discharge: to a runoff coefficient and drainage area by use of a regression equation developed for drainage of flat topographic areas was the principal method of analysis (U.S. Department of Agriculture, 1971). Other methods used for comparison of results include application of regional relationships as developed for Kent County, Delaware, by the study contractor from a previous study (Greenhorne & O'Mara Inc., 1975); regional relationships (regression equations) relating to peak discharge with drainage area, a runoff coefficient, and average basin slope as developed in a previous study (Delaware Department of Highways and Transportation, 1972); and a regional log-Pearson Type III Study, which includes all available streamflow records for Kent County, Delaware, and additional data generated by a synthetic streamflow model (USACE, 1972).

Tantrough Branch peak discharges were determined using R H. Simmons and D. H. Carpenter's Regional Method (Simmons and Carpenter, 1978).

The hydrologic analyses of the Isaac Branch within the Town of Camden were also prepared by Greenhorne & O'Mara, Inc., for their FIS for the unincorporated areas of Kent County (U.S. Department of Housing and Urban Development, Unincorporated Areas of Kent, 1975). The calculations were based upon synthetic unit hydrograph techniques established by the NRCS (U.S. Department of Agriculture, 1972). This method is appropriate for generally uniform agricultural watersheds, such as that of the St. Jones River, of which Isaac Branch is a tributary. Although the U.S. Geological Survey (USGS) maintains a stream gage on the St. Jones River, it was not considered practical to use a log-Pearson Type III analysis as the primary hydrological method because of the relatively short duration of recorded data from this gage which was established in 1958.

In addition, Kent County and the Towns of Smyrna, Clayton, and the City of Harrington had frequency-discharge drainage curves. These curves delineating the frequency discharges vs. drainage area relationships for the streams studied in detail are displayed in Figure 1. The sharp vertical drops in those “curves” reflect the decrease in discharge caused by storage in the lakes. Downstream decreases in peak discharge on Mill Creek are due to the storage effects of Lake Como.

Initial Countywide Analyses

The peak flows for streams in Kent County, Delaware, were developed using WRI Report 95-4153, “Technique for Estimating Magnitude and Frequency of Peak Flows in Delaware.” Most of the streams in Kent County have never been studied before and have no high water mark information for comparison.

For most of the watersheds, the WRI Report method for ungaged streams was used. St. Jones River and Marshyhope Creek are the only streams in the study to have gages with a usable period of record, 33 and 45 years of record, respectively. For gaged streams, the WRI Report describes a computation to weight the computed flow to the observed gage flows while accounting for the number of years the gage was in operation. For the St. Jones River, this resulted in significantly lower flows. For Marshyhope Creek, the gage data moderately raised flows.

Typically, stream gage records take precedence over empirical methods of hydrology. However, for the St. Jones watershed, the flows that were not weighted for the gage were used for several reasons. The gage flows are dramatically lower than any other estimation of flows for the basin. The gage records appear to reflect the influence of Silver Lake Dam a short distance upstream. The WRI Report results are consistently close to, but slightly higher than the old FIS flows in this drainage basin. These flows also correspond well with the results of the 1996 study of Maidstone Branch conducted by DNREC. The only flow that is greatly out of line with the WRI Report results is the 1-percent annual chance flow calculated on the Dam Inspection Report, seem unrealistically high, especially compared to the gage data, and was not further investigated.

For Marshyhope Creek, the variation in drainage area size from the gage to the other subareas precluded translating the gage weighting factor too far upstream or downstream, so only the flows at points Z and X were weighted.

TR-55 was used for independent verification at two sample locations due to concerns raised by the difference between the empirical method results and gage records on St. Jones River and Marshyhope Creek. Cahoon Branch and Green Branch were chosen for the investigation because they represent different areas within the county, one in the drainage area of each gage, and were small enough not to exceed the time of concentration limit of TR-55. The lack of relief in Kent County's topography yields significantly longer times of concentration than for comparably sized areas in more uneven terrain. The results of TR-55 verified the WRI report results very well. This reinforced the decision to use the unweighted results for the St. Jones watershed and the weighted results for the Marshyhope watershed.

A summary of the drainage area-peak discharge relationships for all streams studied by detailed methods are shown in Table 4, “Summary of Discharges,” except for Brown's Branch North, Brown's Branch South, Green's Branch, Mill Creek, Stream No. 1, and Tidbury Creek which are shown in Figure 1, “Frequency-Discharge, Drainage Area Curves**,”** and Tidy Island Creek, Willow Grove Prong, and Providence Creek, which are continuations of Choptank River, Cow Marsh Creek, and Duck Creek, respectively.

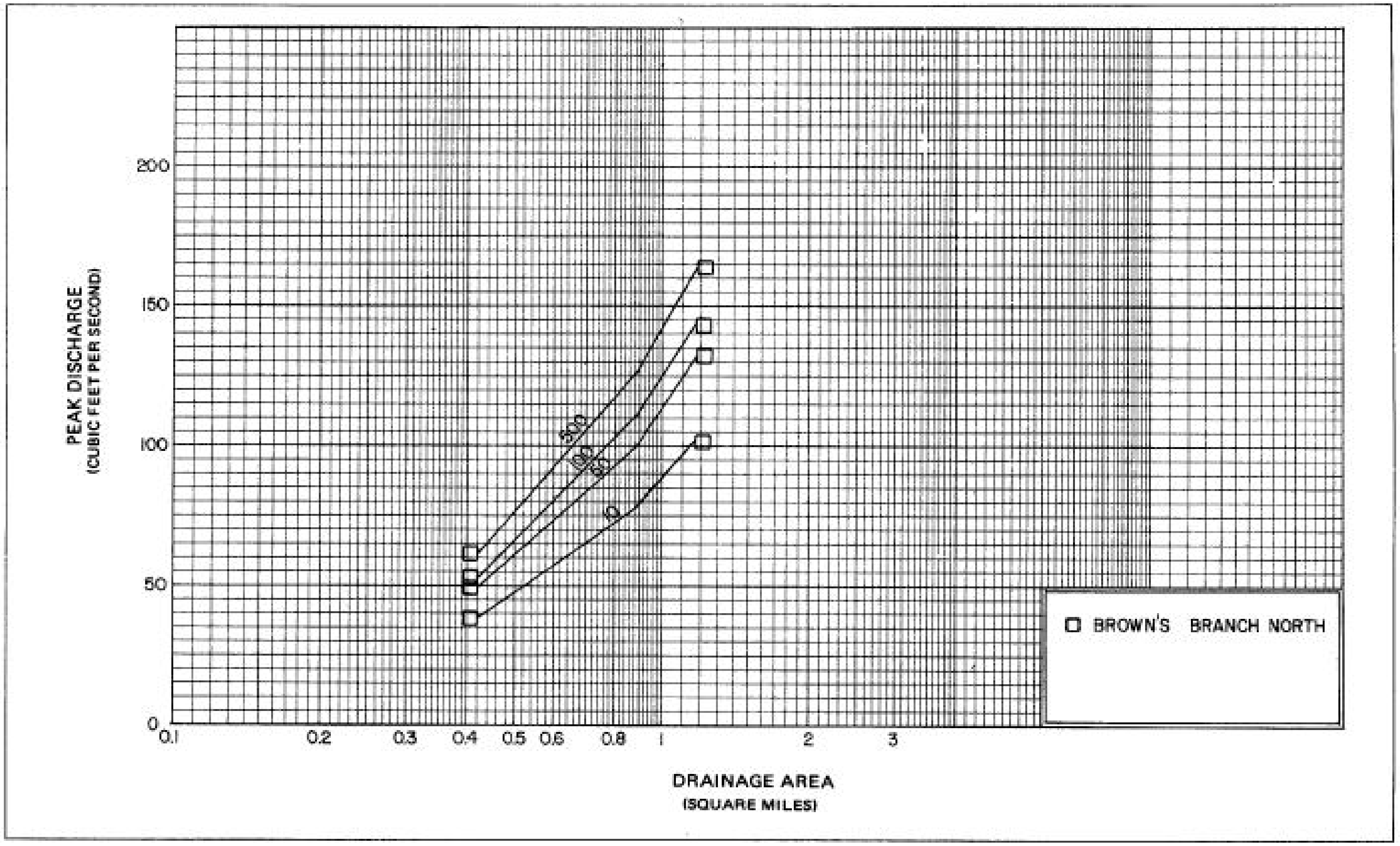

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

BROWN'S BRANCH NORTH

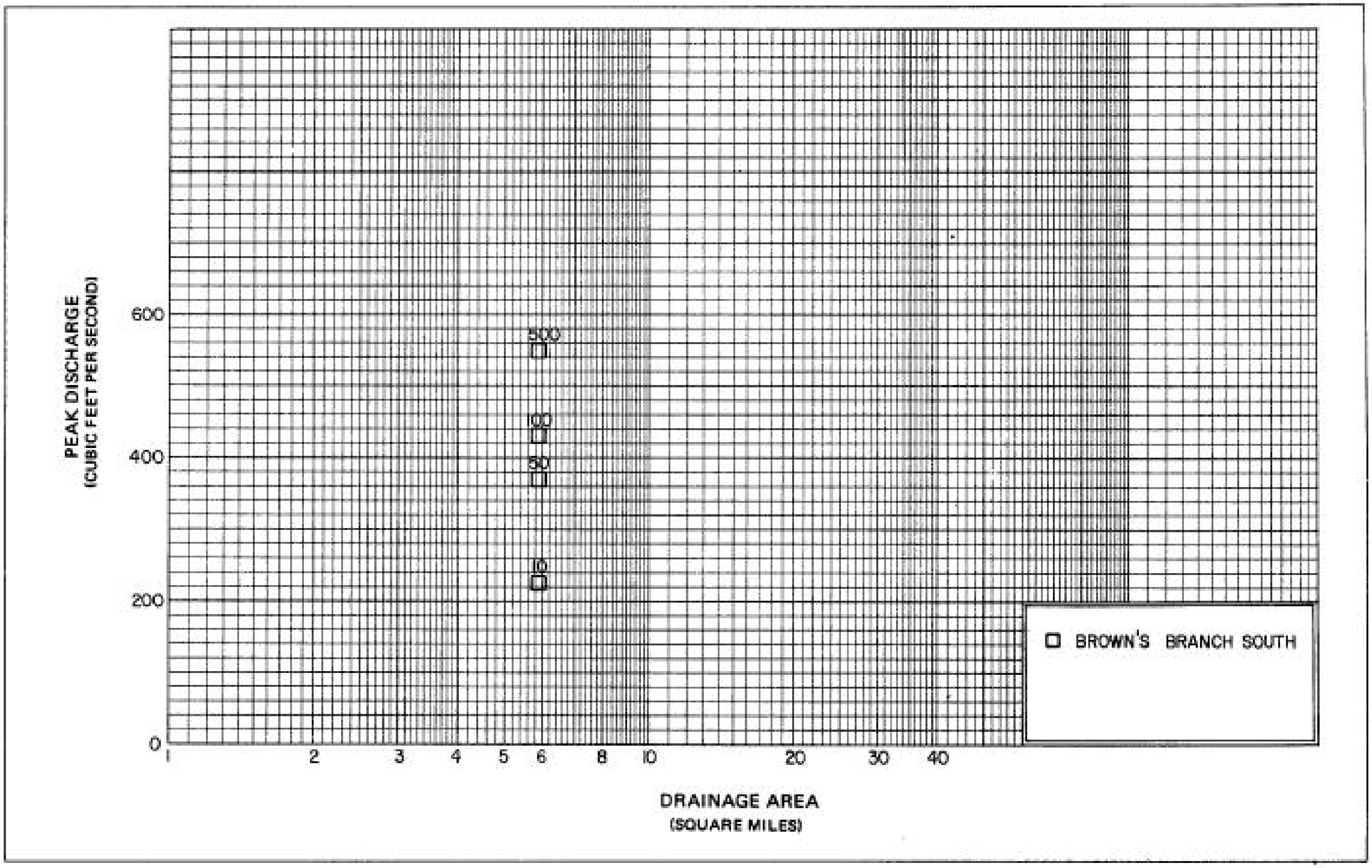

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

BROWN'S BRANCH SOUTH

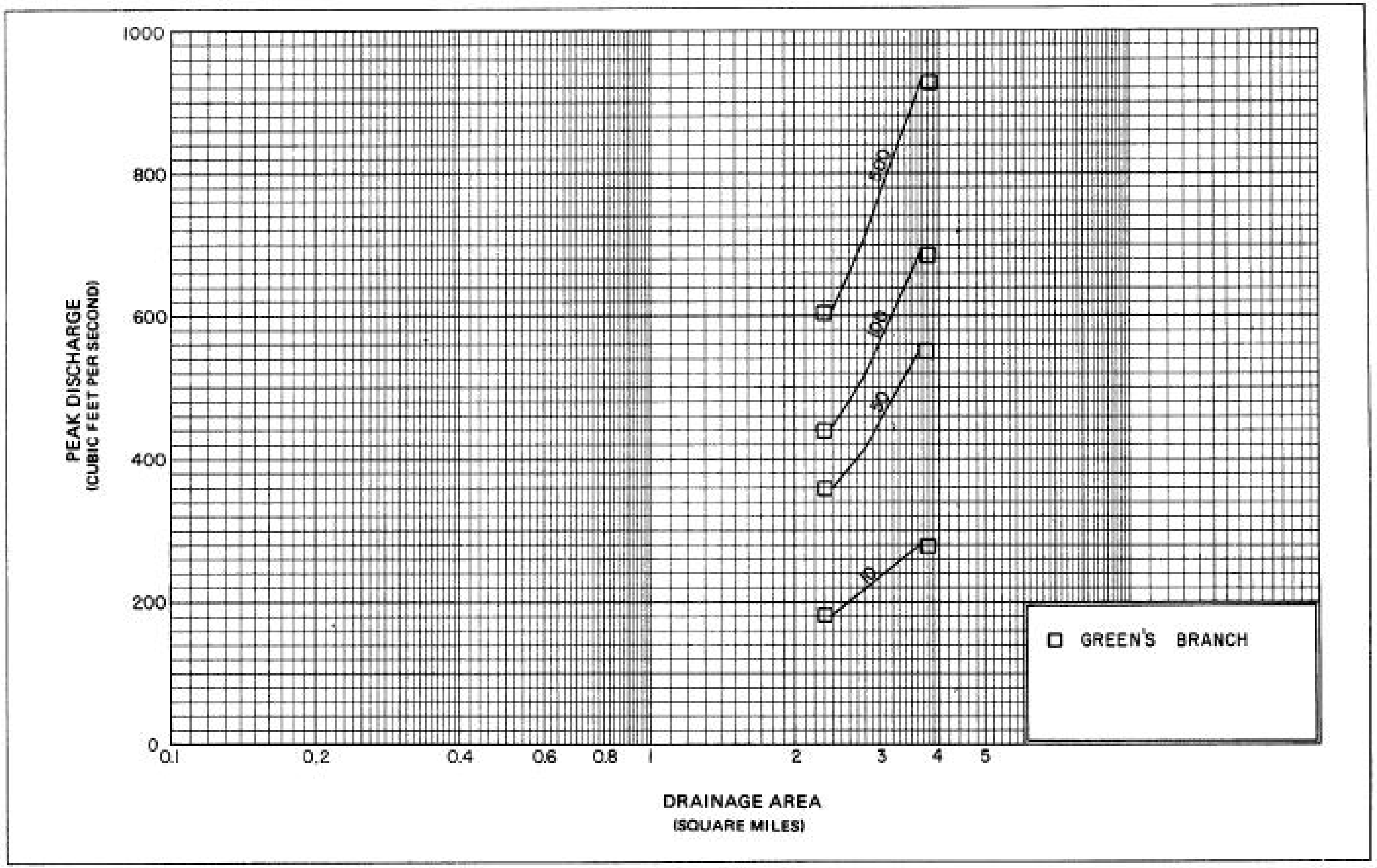

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

GREEN'S BRANCH

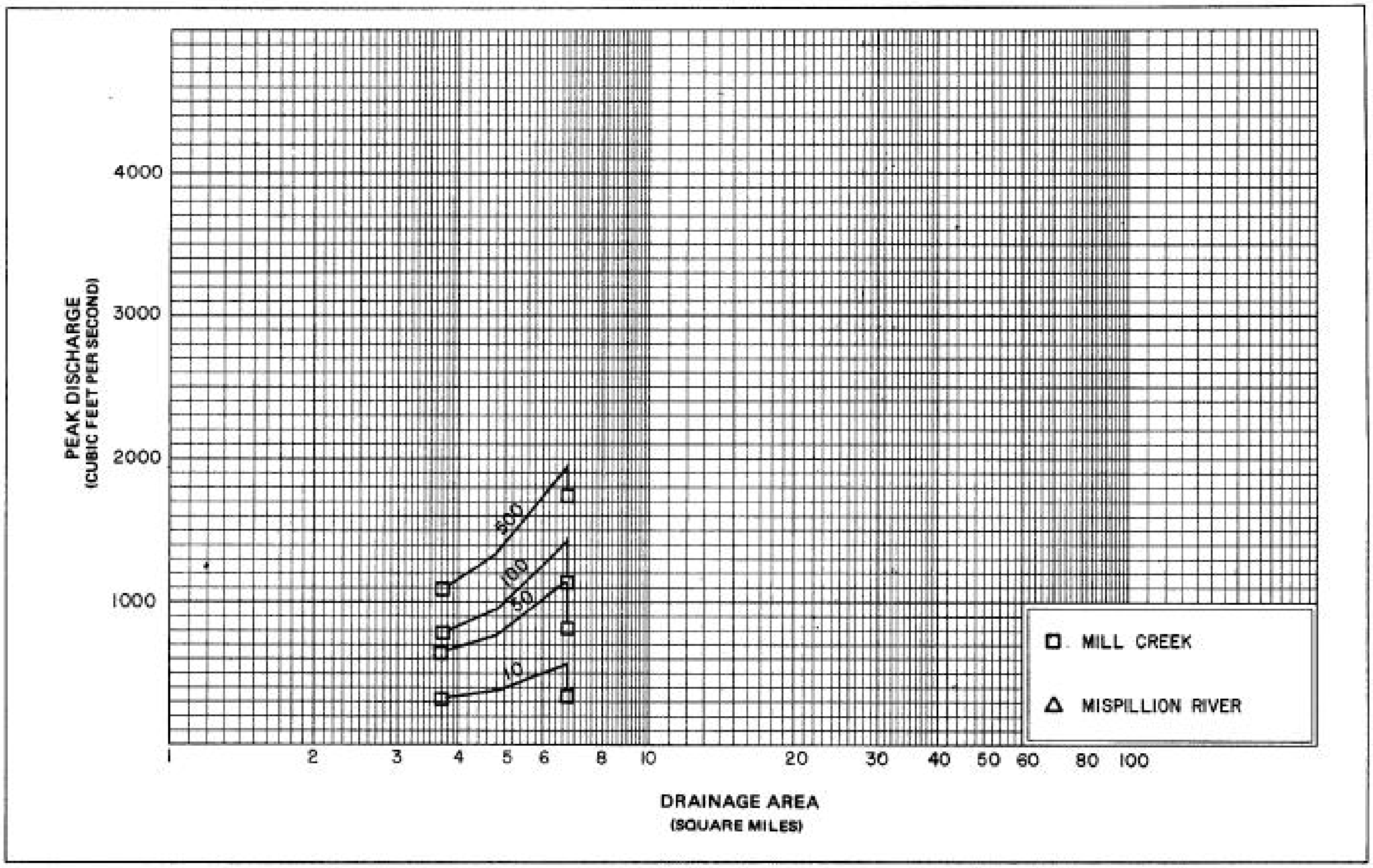

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

**KENT COUNTY, DE
AND INCORPORATED AREAS**

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

MILL CREEK

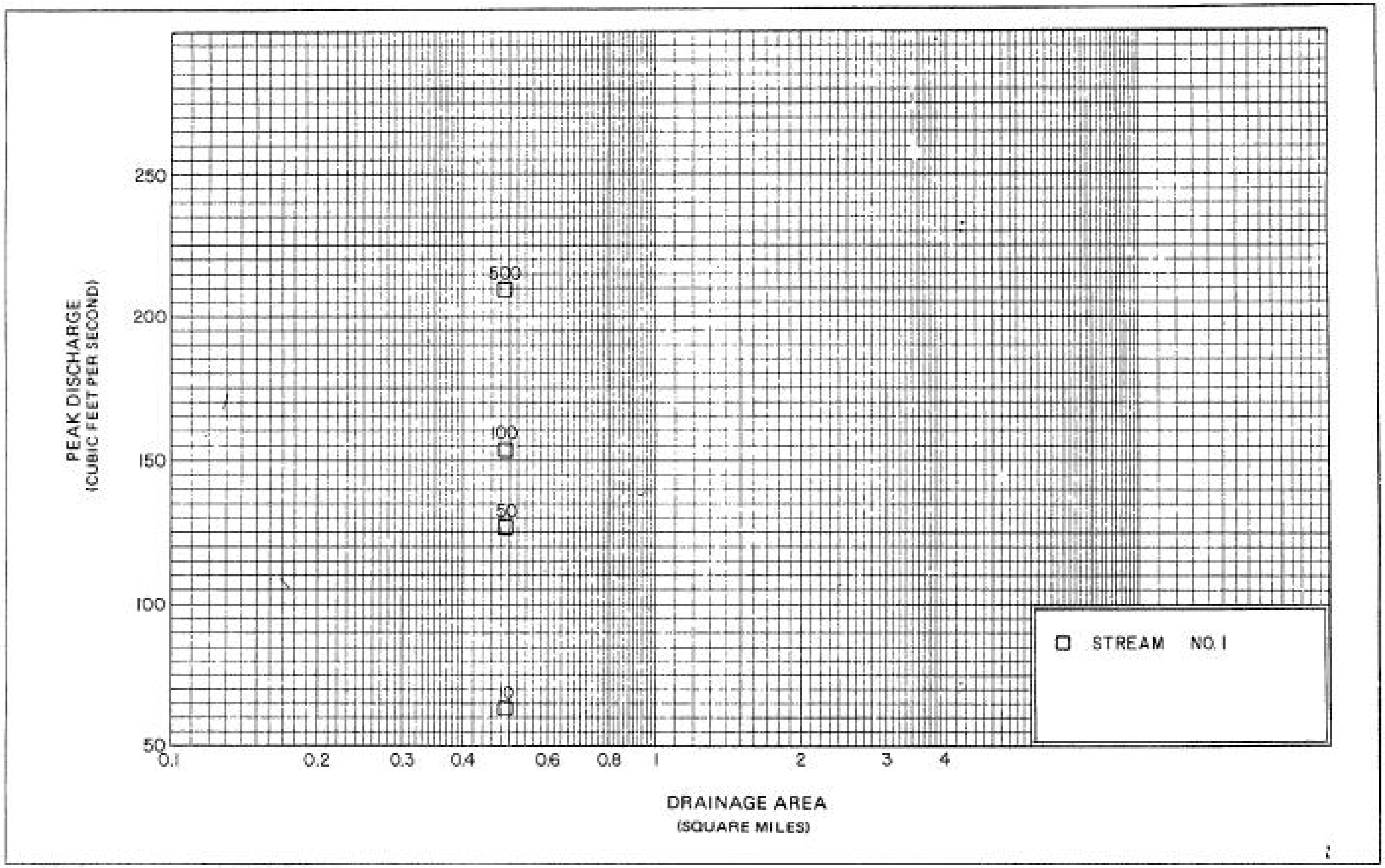

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

STREAM NO. 1

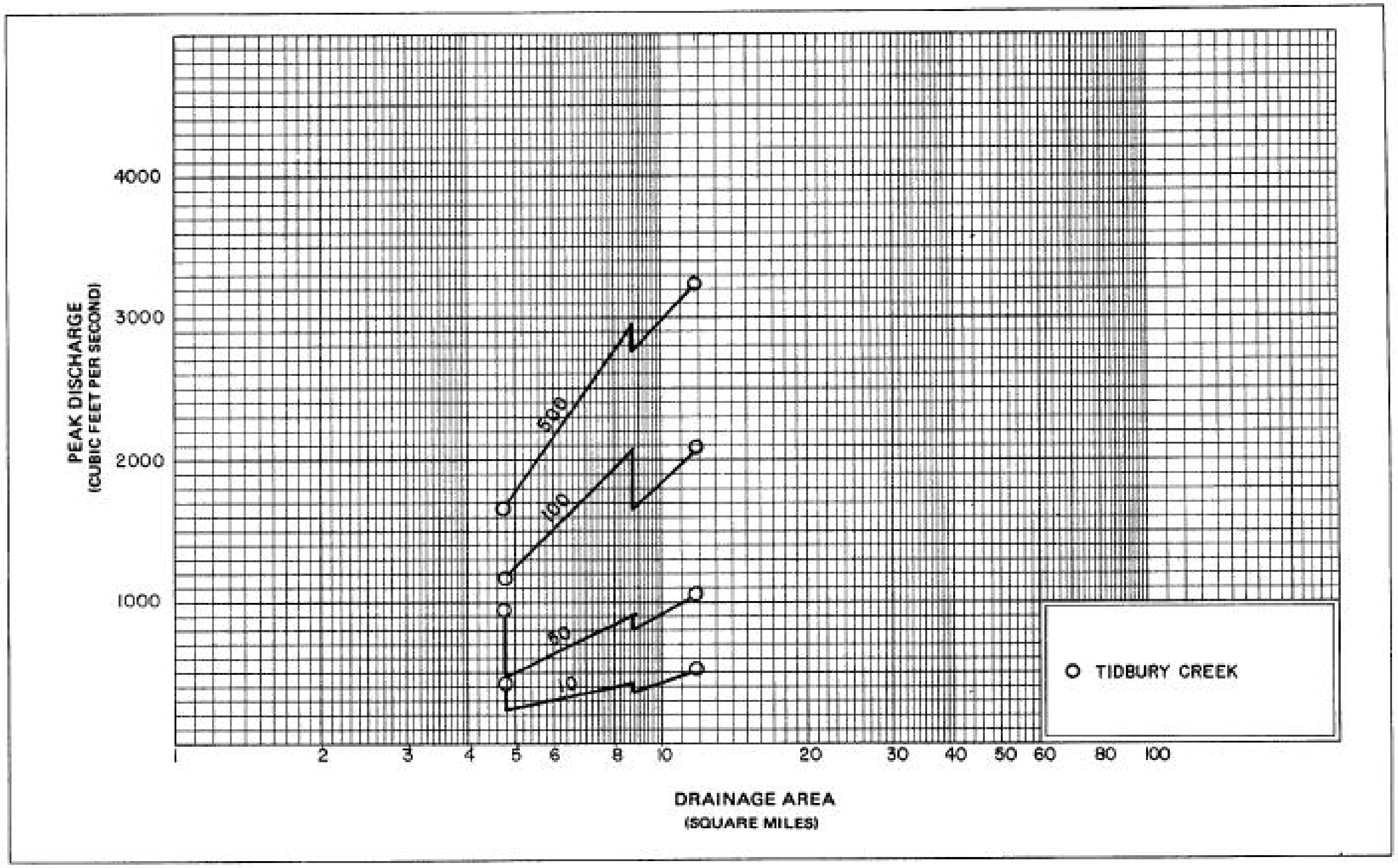

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FREQUENCY - DISCHARGE, DRAINAGE AREA CURVES

TIDBURY CREEK

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
ANDREWS LAKE					
At downstream end of lake	6.32	648	1,490	2,005	3,904
BEAVERDAM DITCH					
At confluence with Tidy Island Creek	9.4	659	1,331	1,685	2,857
CAHOON BRANCH					
At confluence with Maidstone Branch	6.68	667	1,444	1,883	3,400
Approximately 0.6 mile upstream of State Route 8	3.44	355	777	1,018	1,867
CHOPTANK RIVER					
Downstream of confluence of Cow Marsh Creek	94.79	2,438	4,483	5,468	8,508
Upstream of confluence of Cow Marsh Creek	57.12	1,910	3,582	4,400	6,955
Upstream of confluence of Culbreth Marsh Ditch	37.61	1,401	2,702	3,365	5,499
COURSEY POND					
At downstream end of lake	20.84	739	1,509	1,942	3,456
COW MARSH CREEK					
At confluence with Choptank River	35.83	1,327	2,490	3,055	4,824
Upstream of confluence of Meredith Branch	23.03	693	1,295	1,590	2,518
Upstream of confluence of Iron Mine Branch	13.1	444	852	1,058	1,724
CULBRETH MARSH DITCH					
At confluence with Choptank River	18.03	874	1,706	2,128	3,480
Approximately 2.4 miles upstream of the confluence with Choptank River	13.55	785	1,557	1,954	3,239
DUCK CREEK					
At Smyrna Landing Road	22.56	2,455	5,555	7,400	13,950
Upstream of confluence With Spring Branch	13.5	1,804	4,071	5,401	10,085
FORK BRANCH					
Upstream of confluence with St. Jones River	10.05	913	1,957	2,543	4,552
Upstream of Rose Dale Lane	2.08	208	426	538	912

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
GREEN BRANCH					
At confluence with Marshyhope Creek	7.2	656	1,360	1,735	2,983
HORSEPEN ARM					
At confluence with Marshyhope Ditch	7.12	331	649	814	1,351
ISAAC BRANCH					
At U.S. Route 13	13.24	615	1,220	1,540	2,190
LEIPSIC RIVER					
At eastern corporate limits of Town of Leipsic	39.14	548	3,092	3,757	5,244
Approximately 1,550 feet upstream of eastern corporate limits	38.54	542.8	3,062	3,721	5,194
At State Highway 9	38.44	541.8	3,057	3,715	5,185
LITTLE RIVER					
At confluence with Morgan Branch	6.11	535	1,134	1,466	2,598
At Williams Park	0.68	148	337	447	844
MAIDSTONE BRANCH					
At confluence with St. Jones River	16.65	1,623	3,562	4,680	8,568
Upstream of confluence of Cahoon Branch	8.36	1,147	2,545	3,347	6,138
PENROSE BRANCH					
At confluence with Maidstone Branch	4.55	504	1,070	1,379	2,428
At Pearsons Comer Road	2.1	268	569	732	1,287
MARSHYHOPE CREEK					
At U.S. Route 16 Bridge	63.84	2,192	4,253	5,312	8,701
At Fishers Bridge Road	43.9	2,160	3,653	4,360	6,429
Upstream of confluence of Green Branch	39.37	1,878	3,251	3,908	5,867
MARSHYHOPE DITCH					
Upstream of confluence of Horsepen Arm	7.75	377	753	951	1,610

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
MCCOLLEY POND					
At downstream of end of lake	20.02	654	1,339	1,734	3,146
MCGINNIS POND					
At downstream end of lake	8.42	708	1,578	2,101	4,006
MORGAN BRANCH					
At confluence with Little River	2.61	405	935	1,253	2,409
PUNCHEON BRANCH					
At the confluence with St. Jones River	4.04	520	915	1,110	1,510
At CONRAIL	2.8	230	510	650	920
RED HOUSE BRANCH					
At the confluence with Tidbury Creek	1.48	*	*	909	*
* Data Not Available					
RED HOUSE BRANCH- CONTINUED					
At Lake Front Drive	1.34	*	*	820	*
Upstream of the confluence of Red House Branch Tributary 1	.8	*	*	604	*
RED HOUSE BRANCH TRIBUTARY 1					
At the confluence with Red House Branch	.48	*	*	685	*
ST. JONES RIVER					
Approximately 1.9 miles downstream of U.S. Route 13 Bridge	38.14	2,874	6,252	8,201	14,942
At State Route 8 Bridge	31.9	2,537	5,512	7,219	13,108
At upstream end of Silver Lake	27.8	2,000	4,243	5,498	9,766
TANTROUGH BRANCH					
Upstream of U.S. Route 13	26.4	670	1,250	1,580	2,650
TAPPAHANNA DITCH					
At confluence with Tidy Island Creek	17.75	1,017	2,030	2,557	4,273
Downstream of Hourglass Road	6.8	407	810	1,018	1,698
Upstream end of Mud Mill Pond	34.76	1,348	2,607	3,251	5,324

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
TIDBURY CREEK					
At US Route 13	5.87	*	*	1924	*
At Steeles Ridge Road	2.10	*	*	1027	*
Upstream of the confluence of Tidbury Creek Tributary 3	.57	*	*	576	*
TIDBURY CREEK TRIBUTARY 1					
Upstream of the confluence with Tidbury Creek	.58	*	*	284	*
TIDBURY CREEK TRIBUTARY 2					
Upstream of the confluence with Tidbury Creek	.16	*	*	256	*
TIDBURY CREEK TRIBUTARY 3					
Upstream of the confluence with Tidbury Creek	1.41	*	*	794	*

* Data Not Available

Water-surface elevations for Wyoming Lake were also adopted from the FIS for the unincorporated areas of Kent County (U.S. Department of Housing and Urban Development, 1975). The Stillwater elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods and are summarized in Table 5, "Summary of Stillwater Elevations."

TABLE 5 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	PEAK DISCHARGES (feet*)			
	10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
WYOMING LAKE	29.5	30.1	30.3	30.6

*North American Vertical Datum of 1988

July 7, 2014 Countywide Revision

For the July 7, 2014 revision, hydrologic results from a hydrologic report developed for the Murderkill Watershed by URS Corporation under Purchase Order number 07010106622 for the Delaware Department of Natural Resources and Environmental Control (DNREC) were used to model the streams studied by limited detailed methods (URS, 2010). The hydrologic model for the Murderkill Watershed was developed using data obtained from previous studies as well as data gathered from field reconnaissance of Delaware dams and current Geographic Information System (GIS) datasets, National Oceanic and Atmospheric Administration (NOAA) Atlas 14 precipitation data (NOAA, 2009), and U.S. Geological Survey (USGS) gage streamflow data (USGS, 2009).

URS prepared a comprehensive hydrologic model of the Murderkill Watershed using GIS mapping tools and the USACE Hydrologic Engineering Center's (HEC) Hydrological Modeling System (HMS): HEC-HMS (version 3.3) (USACE, 2008). ArcGIS 9.2-based (ESRI, 2006) ArcHydro (CRWR, 2007) and HEC-GeoHMS models (USACE, 2003) were also used to complete the HEC-HMS model. Terrain preprocessing was developed using the ArcHydro tool. Basin processing and HEC-HMS model setup were performed using HEC-GeoHMS.

A summary of the drainage area-peak discharge relationships for the streams studied by limited detailed methods is shown in Table 6, "Summary of Discharges, Limited Detailed Streams."

This Countywide Revision

For this revision, the 1%-annual-chance peak flows for Limited Detailed Study streams were developed using U.S. Geological Survey Scientific Investigations Report 2006-5146, "Magnitude and Frequency of Floods on Nontidal Streams in Delaware." Urban regression equations were not applied to this study. All studied streams are located in the coastal plain region. Soil data parameters were calculated using data acquired from the Natural Resources Conservation Service (NRCS) – State Soil Geographic (STATSGO) Database (http://www.ncgc.nrcs.usda.gov/products/datasets/statsgo/index.html).

A summary of the drainage area-peak discharge relationships for the streams studied by limited detailed methods during this countywide revision is shown in Table 6, "Summary of Discharges, Limited Detailed Streams."

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BEAVERDAM BRANCH					
Approximately 192 feet downstream of the confluence with Beaverdam Branch Trib 1	1.06	1,160	1,800	2,260	3,000

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BEAVERDAM BRANCH (continued)					
Approximately 1,526 feet above the confluence with Beaverdam Branch Trib 1	0.41	78	164	215	367
BEAVERDAM BRANCH TRIBUTARY 1					
Approximately 1,391 feet upstream of confluence with Beaverdam Branch	0.34	1,275	2,070	2,485	3,250
BLACK ARM BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	3.05	*	*	747	*
Approximately 605 feet upstream of Park Brown Road	2.79	*	*	852	*
Approximately 0.27 miles downstream of Fox Hunters Road	2.27	*	*	875	*
Upstream of confluence with Black Arm Branch Prong 5	1.71	*	*	711	*
Approximately 123 feet downstream of Hills Market Road	1.35	*	*	650	*
Approximately 0.25 miles upstream of Hills Market Road	0.52	*	*	287	*
BLACK ARM BRANCH PRONG 4					
Upstream of confluence with Black Arm Branch	2.94	*	*	920	*
Approximately 0.24 miles downstream of Park Brown Road	2.18	*	*	860	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BLACK ARM BRANCH PRONG 5					
Upstream of confluence with Black Arm Branch	0.31	*	*	211	*
BLACK SWAMP CREEK					
Approximately 3,620 feet downstream of Little Mastens Corner	10.5	861	1,799	2,352	4,060
Approximately 971 feet downstream of Little Mastens Corner	5.71	761	1,546	2,000	3,383
Approximately 1,055 feet upstream of Hopkins Cemetery	5.09	640	1,273	1,636	2,733
Approximately 1,390 feet downstream of State Hwy 12	2.47	259	510	652	1,080
BRIGHT HAINES BRANCH					
Upstream of confluence with Marshyhope Creek	14.66	*	*	1,651	*
Upstream of confluence of Point Branch Main	12.91	*	*	1,288	*
Upstream of confluence of Prospect Branch	10.06	*	*	1,414	*
BRIGHT HAINES BRANCH FARMINGTON PRONG					
Upstream of confluence with Bright Haines Branch	4.45	*	*	1,375	*
Upstream of confluence with Bright Haines Branch Farmington Prong Prong 5	2.82	*	*	1,021	*
Upstream of confluence with Bright Haines Branch Farmington Prong Prong 10	0.99	*	*	518	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BRIGHT HAINES BRANCH FARMINGTON PRONG PRONG 5					
Upstream of confluence with Bright Haines Branch Farmington Prong Prospect Branch	1.13	*	*	683	*
Upstream of confluence with Bright Haines Branch Farmington Prong Prong 5 Tributary 2	0.94	*	*	469	*
BRIGHT HAINES BRANCH FARMINGTON PRONG PRONG 5 TRIBUTARY 2					
Upstream of confluence with Bright Haines Branch Farmington Prong Prong 5	0.08	*	*	91	*
BRIGHT HAINES BRANCH FARMINGTON PRONG PRONG 10					
Upstream of confluence with Bright Haines Branch Farmington Prong Prospect Branch	1.46	*	*	665	*
BRIGHT HAINES BRANCH HARRINGTON PRONG					
Upstream of confluence with Bright Haines Branch Farmington Prong Prospect Branch	5.40	*	*	1,030	*
Approximately 93 feet downstream of Flat Iron Road	5.07	*	*	1,432	*
Upstream of confluence with Bright Haines Branch Harrington Prong Prong 7	2.43	*	*	932	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BRIGHT HAINES BRANCH HARRINGTON PRONG (continued)					
Approximately 231 feet upstream of confluence with Bright Haines Branch Harrington Prong Prong 8	2.27	*	*	916	*
Approximately 0.67 miles upstream of confluence with Bright Haines Branch Harrington Prong Prong 8	0.65	*	*	366	*
BRIGHT HAINES BRANCH HARRINGTON PRONG PRONG 7					
Upstream of confluence with Bright Haines Branch Harrington Prong	1.30	*	*	632	*
Approximately 0.65 miles upstream of confluence with Bright Haines Branch Harrington Prong	0.73	*	*	410	*
BRIGHT HAINES BRANCH HARRINGTON PRONG PRONG 8					
Upstream of confluence with Bright Haines Branch Harrington Prong	0.16	*	*	146	*
BROWNS BRANCH					
Approximately 931 feet upstream of Jackson Ditch Road	8.91	755	1,817	2,462	4,553
Approximately 517 feet upstream of Doctor Smith Road	3.5	416	948	1,267	2,267
Approximately 556 feet downstream of Cluckey Drive	3.14	238	533	709	1,257

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
BROWNS BRANCH TRIBUTARY 1					
Approximately 49 feet upstream of US Hwy 13	1.83	237	534	705	1,244
Approximately 446 feet upstream of Simmons Street	1.38	118	258	340	594
BROWNSVILLE BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	2.22	*	*	768	*
Approximately 103 feet downstream of Fox Hunters Road	1.87	*	*	766	*
Approximately 248 feet downstream of Brownsville Road	1.33	*	*	638	*
CAT TAIL BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	11.63	*	*	1,654	*
Upstream of confluence with Saulsbury Creek	6.16	*	*	1,251	*
Approximately 200 feet downstream of Cattail Branch Road	5.28	*	*	1,467	*
Upstream of confluence with Cat tail Branch Prong 8	3.35	*	*	1,068	*
Approximately 0.22 miles upstream of High Stump Road	1.74	*	*	786	*
CAT TAIL BRANCH PRONG 8					
Upstream of confluence with Cattail Branch	0.91	*	*	532	*
Approximately 171 feet downstream of High Stump Road	0.63	*	*	364	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
DOUBLE RUN					
Approximately 230 feet upstream of Barney Jenkins Road/County Hwy 370	8.04	744	1,774	2,408	4,425
Approximately 1214 feet upstream of Irish Hill Road	4.42	442	1,010	1,349	2,410
FAN BRANCH					
Approximately 248 feet upstream of State Hwy 13	0.9	115	222	282	461
GRAMBULL BRANCH					
Upstream of confluence with Ingram Branch	1.13	*	*	216	*
GREEN BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	7.28	*	*	1,210	*
Upstream of confluence with Green Branch Prong 17 Tributary 1	2.00	*	*	922	*
Upstream of confluence with Green Branch Prong 20	1.15	*	*	638	*
Upstream of confluence with Green Branch Prong 22	0.77	*	*	415	*
GREEN BRANCH PRONG 17					
Upstream of confluence with Green Branch	0.27	*	*	359	*
Upstream of confluence with Green Branch Prong 17 Tributary 1	0.14	*	*	125	*
GREEN BRANCH PRONG 17 TRIBUTARY 1					
Approximately 55 feet upstream of confluence with Green Branch Prong 17	0.09	*	*	86	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
GREEN BRANCH PRONG 20					
Upstream of confluence with Green Branch	0.62	*	*	287	*
HORSEPEN ARM					
Upstream of confluence with Horsepen Arm Branch Prong 4	3.66	*	*	1,027	*
Approximately 669 feet upstream of Park Brown Road	2.39	*	*	844	*
Approximately 122 feet downstream of Toby Collins Lane	1.79	*	*	804	*
Approximately 60 feet upstream of confluence with Horsepen Arm Branch Prong 10	1.42	*	*	670	*
Approximately 46 feet upstream of confluence with Horsepen Arm Branch Prong 11	1.16	*	*	528	*
HORSEPEN ARM BRANCH PRONG 4					
Upstream of confluence with Horsepen Arm	1.23	*	*	569	*
HUDSON BRANCH					
Approximately 309 feet upstream of US Hwy 13	7.04	470	1,071	1,435	2,593
Approximately 440 feet downstream of Firetower Road	3.65	306	682	907	1,611
Approximately 90.9 feet downstream of Firetower Road	1.72	104	231	307	543
INGRAM BRANCH					
Approximately 0.50 miles upstream of Gregg Road	5.88	*	*	503	*
Approximately 0.27 miles downstream from Ingram Branch Road	4.83	*	*	561	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
INGRAM BRANCH(continued)					
Upstream of confluence with Grambull Branch	2.91	*	*	432	*
Upstream of confluence with Ingram Branch Prong 2	1.61	*	*	400	*
Approximately 455 feet downstream of Whiteleysburg Road	1.16	*	*	527	*
INGRAM BRANCH PRONG 2					
Approximately 0.32 miles downstream of Whiteleysburg Road	0.74	*	*	274	*
MURDERKILL RIVER					
Approximately 30 feet upstream of Killens Pond Road	6.22	891	1,852	2,626	5,184
Approximately 39 feet upstream of US Hwy 13	5.83	1,148	2,492	3,305	5,878
Approximately 108 feet downstream of confluence with Fan Branch	2.04	548	1,132	1,463	2,466
Approximately 1,021 feet upstream of Little Masons Corner	1.24	356	739	954	1,602
Approximately 4,800 feet above confluence with Beaverdam Branch	0.9	113	224	287	476
POINT BRANCH MAIN					
Upstream of confluence with Bright Haines Branch	1.65	*	*	731	*
Approximately 119 feet downstream of Prospect Church Road	1.18	*	*	577	*
Approximately 0.69 miles upstream of Prospect Church Road	1.01	*	*	505	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
PRATT BRANCH					
Approximately 66 feet downstream of Andrews Lake Road	6.46	287	736	1,026	1,941
Approximately 263 feet south of Memorial Avenue	6.06	311	817	1,139	2,187
PROSPECT BRANCH					
Upstream of confluence with Bright Haines Branch Farmington Prong Prospect Branch	2.70	*	*	733	*
Approximately 158 feet downstream of Delaware State Highway 14	2.50	*	*	849	*
Approximately 64 feet downstream of Hemping Road	1.93	*	*	786	*
Approximately 0.20 miles downstream of Cornish Road	1.14	*	*	548	*
QUARTER BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	4.81	*	*	511	*
Approximately 0.25 miles downstream of Todds Chapel Road	4.42	*	*	787	*
Upstream of confluence with Quarter Branch Prong 3	2.71	*	*	1,009	*
QUARTER BRANCH PRONG 3					
Upstream of confluence with Quarter Branch	1.38	*	*	218	*
SAULSBURY CREEK					
Upstream of confluence with Cattail Branch	4.25	*	*	1,361	*
Approximately 0.37 miles upstream of Burrsville Road	3.78	*	*	1,840	*
Upstream of confluence with Saulsbury Creek Prong 2	2.58	*	*	1,006	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
SAULSBURY CREEK(continued)					
Upstream of confluence with Saulsbury Creek Prong 3	2.28	*	*	1,053	*
Approximately 80 feet upstream of the confluence with Saulsbury Creek Prong 5	1.73	*	*	991	*
Upstream of confluence with Saulsbury Creek Prong 6	1.18	*	*	816	*
SAULSBURY CREEK PRONG 2					
Upstream of confluence with Saulsbury Creek	1.01	*	*	1,036	*
Approximately 0.38 miles upstream of confluence with Saulsbury Creek	0.83	*	*	899	*
Approximately 43 feet downstream of confluence with Saulsbury Creek Prong 2 Tributary 2	0.32	*	*	405	*
Upstream of confluence with Saulsbury Creek Prong 2 Tributary 3	0.23	*	*	176	*
SAULSBURY CREEK PRONG 2 TRIBUTARY 2					
Upstream of confluence with Saulsbury Creek Prong 2	0.24	*	*	182	*
SAULSBURY CREEK PRONG 2 TRIBUTARY 3					
Upstream of confluence with Saulsbury Creek Prong 2	0.09	*	*	96	*
SAULSBURY CREEK PRONG 3					
Approximately 112 feet upstream of confluence with Saulsbury Creek	0.30	*	*	214	*
Approximately 150 feet upstream of confluence with Saulsbury Creek	0.43	*	*	281	*

TABLE 6 - SUMMARY OF DISCHARGES, LIMITED DETAILED STREAMS - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
SAULSBURY CREEK PRONG 8					
Upstream of confluence with Saulsbury Creek	0.06	*	*	78	*
SAULSBURY CREEK PRONG 9					
Upstream of confluence with Saulsbury Creek	0.36	*	*	243	*
SPRING BRANCH					
Approximately 406 feet upstream of US Hwy 13	2.83	174	441	608	1,146
TOMAHAWK BRANCH					
Upstream of confluence with Black Arm Branch Prong 4	1.94	*	*	513	*
Approximately 96 feet upstream of confluence with Tomahawk Branch Prong 1	1.50	*	*	485	*
Approximately 104 feet upstream of confluence with Tomahawk Branch Prong 2	1.22	*	*	460	*
Approximately 237 feet downstream of Todds Chapel Road	0.85	*	*	524	*
Approximately 172 feet downstream of Greenwood Road	0.48	*	*	299	*

*Data not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this countywide FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if the hydraulic structures remain unobstructed, operate properly, and do not fail.

Pre-countywide Analyses

For each community within Kent County that has a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Cross sections for the backwater analyses for Mill Creek, Green's Branch, Leipsic River, Puncheon Branch, Isaac Branch, Stream No. 1, and Tidbury Creek were compiled using field-surveyed sections which were extended where necessary by using existing USGS topographic maps. These sections were located at close intervals above and below bridges and culverts, in addition to points in the floodplain, in order to determine backwater effects of these structures in urbanized areas.

A detailed hydraulic analysis was not performed for Dyke Branch, the Murderkill River, Spring Creek, and Tributary Number 1 to Spring Creek since they are subject to tidal action. Based on this determination, flood profiles were not computed. However, numerous cross sections were surveyed at selected locations, in order that the floodplains could be more accurately defined.

Cross sections for the backwater analyses for Brown's Branch North and Brown's Branch South and Tantrough Branch were obtained by field measurement. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Water-surface profiles for Brown's Branch North, Brown's Branch South, Green's Branch, Leipsic River, Stream No. 1, Mill Creek, Puncheon Branch, Isaac Branch, Tantrough Branch, and Tidbury Creek were developed using a USACE HEC-2 computer step-backwater model (USACE, 1991).

Water-surface elevations in the lakes studied in detail were obtained by flood routing with the TR-20 hydrology program. This was accomplished by deriving rating curves for the spillways and storage elevation curves for each lake. The spillway rating curves for each procedure used by the agency or individual responsible for maintaining the lake.

Starting water-surface elevations for Isaac Branch, Leipsic River, Mill Creek, Puncheon Branch, and Tidbury Creek are governed by the tidal elevation on the Delaware Bay. Due to the convergence of the Delaware Bay as it approaches the Delaware River at its north end, the tidal elevations in the Delaware Bay are not uniform. As the tidal surge moves up the bay, the water surface increases as the bay narrows. Therefore, the tidal elevations at the north end of the bay are higher than at the south end. Since there were three distinct points where the rivers studied in detail meet the bay, separate tidal elevations had to be determined for the southern, the central, and the northern regions of the Bay Shore Area. The bay tidal elevations for the recurrence intervals used were derived from using information from a study by the USACE (USACE, 1963).

Starting tidal elevations were taken from a tide elevation-frequency curve computed for the Town of Leipsic (U.S. Department of Commerce, 1976; U.S. Department of Housing and Urban Development, City of Lewes, 1975; U.S. Department of Housing and Urban Development, Delaware City, 1975; USACE, 1963). These starting elevations were used, along with riverine data from the hydraulic analysis, in the NRCS WSP-2 Computer Program (U.S. Department of Agriculture, 1976). Analysis of resulting profiles showed that riverine flow has no effect on flood elevations within corporate limits, but rather that tides from the Delaware Bay determine flood elevations in the Town of Leipsic.

Starting elevations for Brown's Branch North and Brown's Branch South used in the backwater analysis were developed by the slope/area method. Significant backwater-producing structures were identified by field reconnaissance and analysis of the HEC-2 computer model output. The backwater effect of a tributary to Brown's Branch North, located in the vicinity of the intersection of Brown's Branch North and U.S. Highway 13, was considered in the hydraulic analysis of Brown's Branch North.

Water-surface elevations for Tantrough Branch were computed using the USACE HEC-2 step-backwater computer model (USACE, 1973).

Water-surface elevations in the Town of Smyrna were computed using the USACE HEC-2 step-backwater computer model (USACE, 1973). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Computed profiles for the Lake Como reach of Mill Creek compared well with elevation data of historical floods supplied by local residents and community officials at the coordination meeting. Information for comparison on Green's Branch and Stream No. 1 was unavailable. Significant backwater producing structures were identified by field reconnaissance and analysis of the HEC-2 computer model output. Elevations for Lake Como were determined by standard computerized flood routing techniques (U.S. Department of Agriculture, 1972). High tailwater and submergence effects were considered in the development of discharge curves for Lake Como spillway structures used in the reservoir routing. Elevations determined for the 10-, 2-, 1-, and .2- percent annual chance floods on Lake Como were used as the starting elevations for the backwater analysis of Stream No. 1. The starting elevations for Green's Branch were governed by normal depth computed by slope/area method.

Initial Countywide Analyses

The hydraulic characteristics of the streams in Kent County were studied to determine the elevations of floodwaters for the 10-, 2-, 1-, and .2- percent annual chance recurrence intervals. These water-surface elevations were computed using the USACE HEC-RAS River Analysis System computer program (USACE, HEC-RAS, 1998).

The cross sections for the hydraulic analysis were obtained from the Digital Terrain Model, which was developed from aerial photography flown in February 1998 (USACE, DTM, 1998; USACE, 1993).

Along certain portions of Andrews Lake, McColley Pond, McGinnis Pond, and St. Jones River, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles and floodway data tables.

Roughness factors (Manning's “n”) were chosen by engineering judgment and were based on inspection of aerial photography and field visits (Table 7). In addition, photographs were taken in vicinity of all structures, and of typical locations for comparison with established published data for determining “n” values (Ven te Chow, 1959). The channel “n” and overbank “n” values for all the streams studied by detailed methods are shown in the tabulation below.

TABLE 7 - MANNING'S "n" VALUES

Flooding Source	Channel “n” Values	Overbank “n” Values
Andrews Lake	0.030-0.045	0.12
Beaverdam Ditch	0.040	0.05-0.12
Brown's Branch North	0.013-0.040	0.045-0.060
Brown's Branch South	0.013-0.040	0.045-0.060
Cahoon Branch	0.045-0.120	0.045-0.120
Choptank River	0.030-0.045	0.045-0.12
Tidy Island Creek	0.030-0.045	0.045-0.12
Coursey Pond	0.030-0.045	0.12
Cow Marsh Creek	0.040-0.045	0.05-0.12
Willow Grove Prong	0.040-0.045	0.05-0.12
Culbreth Marsh Ditch	0.030-0.045	0.05-0.12
Duck Creek	0.03-0.08	0.013-0.080
Providence Creek	0.03-0.08	0.013-0.080
Fork Branch	0.045	0.12
Green Branch	0.035	0.045-0.080
Green's Branch	0.013-0.040	0.045-0.080
Horsepen Arm	0.030-0.10	0.035-0.100

TABLE 7 - MANNING'S "n" VALUES - CONTINUED

Flooding Source	Channel “n” Values	Overbank “n” Values
Isaac Branch	0.04	0.05-0.08
Leipsic River	0.030-0.035	0.070-0.100
Little River	0.04-0.07	0.03-0.12
Maidstone Branch	0.045	0.120
Penrose Branch	0.045	0.120
Marshyhope Creek	0.024-0.100	0.024-0.100
Marshyhope Ditch	0.024-0.100	0.024-0.100
McColley Pond	0.030-0.045	0.03-0.12
McGinnis Pond	0.030-0.045	0.12
Mill Creek	0.013-0.040	0.045-0.080
Morgan Branch	0.045	0.05-0.12
Puncheon Branch	0.035	0.092-0.104
St. Jones River	0.030-0.045	0.04-0.12
Stream No. 1	0.013-0.040	0.045-0.080
Tantrough Branch	0.033-0.035	0.05-0.15
Tappahana Ditch	0.04	0.05-0.12
Tidbury Creek	*	*

* Data Not Available

July 7, 2014 Countywide Revision

The hydraulic model used for this revision to the FIS is the USACE Hydraulic Engineering Center River Analysis System (HEC-RAS), Version 4.0 (USACE, 2008). Topographic data for the floodplain and channel cross sections in the limited detailed models was developed using recently acquired Light Detection and Ranging (LiDAR) land data and field measurements of hydraulic and flood control structures. The models also used updated hydrologic data. The models were developed using HEC-RAS 4.0 for the peak 0.2, 1, 2, and 10-percent annual chance frequency storm discharges for the limited detailed studied streams.

Starting conditions for the hydraulic models were set to normal depth using starting slopes calculated from values taken from the LiDAR data or, where applicable, derived from the water surface elevations of existing effective flood elevations.

Roughness factors (Manning's “n”) used in the hydraulic computations were chosen based on orthophotography and field investigation. Table 8A shows the channel and overbank “n” values for the streams studied by limited detailed methods.

This Countywide Revision

HEC-RAS, Version 4.1 (USACE, 2010) was used for hydraulic analyses for this revision. Topographic data for the floodplain and channel cross sections in the limited detailed models was developed using LiDAR data for Kent County acquired in 2007 and field measurements of cross drainage structures. The models used 1-percent annual chance peak flood discharge for the limited detailed study streams.

Starting conditions for the hydraulic models were set to normal depth using starting slopes calculated from values taken from the LiDAR data or, where applicable, derived from the water surface elevations of existing effective flood elevations.

Roughness factors (Manning's “n”) used in the hydraulic computations were chosen based on orthophotography. Table 8A shows the channel and overbank “n” values for the streams studied by limited detailed methods.

Table 8B, “Limited Detailed Flood Hazard Data,” includes flood hazard data for streams studied by limited detailed method during this revision. Flood data tables for each cross section included in this flood study update have been developed.

TABLE 8A – MANNING'S "n" VALUES- LIMITED DETAILED STUDY STREAMS

Stream	Channel "n"	Left Overbank "n"	Right Overbank "n"
Beaverdam Branch	0.055	0.15	0.14-0.15
Beaverdam Branch Tributary 1	0.055	0.15	0.15
Black Arm Branch	0.050-0.120	0.036-0.043	0.050-0.120
Black Arm Branch Prong 4	0.050-0.120	0.041	0.050-0.120
Black Arm Branch Prong 5	0.050-0.120	0.042	0.050-0.120
Black Swamp Creek	0.045-0.055	0.1-0.15	0.1-0.15
Bright Haines Branch	0.050	0.040-0.043	0.050-0.120
Bright Haines Branch Farmington Prong	0.050-0.120	0.042-0.043	0.050-0.120
Bright Haines Branch Farmington Prong Prong 5	0.050-0.120	0.042	0.050
Bright Haines Branch Farmington Prong Prong 5 Tributary 2	0.050-0.120	0.043	0.050-0.120
Bright Haines Branch Farmington Prong Prong 10	0.045-0.12	0.043	0.045-0.120
Bright Haines Branch Harrington Prong	0.100-0.120	0.043	0.120
Bright Haines Branch Harrington Prong Prong 7	0.045-0.120	0.043	0.12
Bright Haines Branch Harrington Prong Prong 8	0.050-0.120	0.042-0.043	0.050-0.120
Browns Branch	0.05- 0.055	0.125-0.15	0.1-0.15
Browns Branch Trib 1	0.04-0.045	0.1-0.15	0.1-0.15
Brownsville Branch	0.045-0.120	0.042	0.045-0.120
Cat Tail Branch	0.045-0.120	0.042	0.045-0.120
Cat Tail Branch Prong 8	0.045-0.120	0.043	0.045-0.120
Double Run	0.05	0.12-0.15	0.13-0.15
Fan Branch	0.045-0.05	0.11-0.15	0.1-0.15
Grambull Branch	0.045-0.120	0.041	0.045-0.120
Green Branch	0.040-0.120	0.039-0.043	0.045-0.120
Green Branch Prong 17	0.045-0.120	0.04-0.042	0.045-0.120
Green Branch Prong 17 Tributary 1	0.045	0.042	0.045

TABLE 8A – MANNING'S "n" VALUES- LIMITED DETAILED STUDY STREAMS

Stream	Channel "n"	Left Overbank "n"	Right Overbank "n"
Green Branch Prong 20	0.045-0.120	0.043	0.045-0.120
Horsepen Arm	0.050-0.120	0.04-0.042	0.050-0.120
Horsepen Arm Branch Prong 4	0.050-0.120	0.042	0.050-0.120
Hudson Branch	0.05	0.12-0.15	0.12-0.15
Ingram Branch	0.045-0.120	0.041-0.12	0.045-0.120
Ingram Branch Prong 2	0.045-0.120	0.043	0.045-0.120
Murderkill River	0.04- 0.05	0.11-0.15	0.13-0.15
Point Branch Main	0.050-0.120	0.042	0.050-0.120
Pratt Branch	0.04-0.05	0.12-0.15	0.12-0.15
Prospect Branch	0.050-0.120	0.042	0.050-0.120
Quarter Branch	0.045-0.120	0.035-0.040	0.045-0.120
Quarter Branch Prong 3	0.045-0.120	0.037-0.041	0.045-0.120
Saulsbury Creek	0.045-0.120	0.042	0.045-0.120
Saulsbury Creek Prong 2	0.045-0.120	0.042	0.045-0.120
Saulsbury Creek Prong 2 Tributary 2	0.045-0.120	0.043	0.060-0.12
Saulsbury Creek Prong 2 Tributary 3	0.045-0.120	0.042	0.045-0.120
Saulsbury Creek Prong 3	0.045-0.120	0.043	0.045-0.120
Saulsbury Creek Prong 8	0.120	0.042	0.120
Saulsbury Creek Prong 9	0.120	0.042	0.120
Spring Branch	0.045-0.05	0.1-0.15	0.1-0.15
Tomahawk Branch	0.045-0.120	0.042-0.12	0.045-0.120

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Black Arm Branch			
A	4,500	852	56.5
B	5,506	852	56.7
C	7,004	875	57.1
D	8,565	875	58.9
E	9,996	711	59.1
F	11,500	711	59.7
G	12,822	711	60.2
H	14,468	650	60.6
I	16,014	287	60.6
J	17,291	287	60.6
K	18,514	287	60.6
Black Arm Branch Prong 4			
A	1000	920	54.8[2]
B	2000	920	54.8[2]
C	3000	920	54.8[2]
D	4000	920	55.4
E	5499	860	55.8
F	6587	860	56.2
G	8000	860	57.0
Black Arm Branch Prong 5			
A	487	211	59.1[2]
B	1,500	211	59.1
C	2,456	211	61.2
D	3,999	211	62.1
Bright Haines Branch			
A	950	1,651	41.9[2]
B	1,500	1,651	41.9[2]
C	2,500	1,288	41.9[2]
D	3,000	1,288	41.9[2]
E	4,000	1,288	41.9[2]
F	5,000	1,414	42.2
G	6,033	1,414	43.3
Bright Haines Branch Farmington Prong			
H	7,078	1,375	48.8
I	8,000	1,375	48.9
J	9,429	1,375	49.1

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Bright Haines Branch Farmington Prong (continued)			
K	10,500	1,375	49.4
L	11,500	1,375	49.8
M	12,500	1,375	50.3
N	13,465	1,021	50.8
O	14,500	1,021	51.5
P	15,506	1,021	52.2
Q	16,925	518	53.7
Bright Haines Branch Farmington Prong Prong 5			
A	242	683	50.5
B	1,000	683	50.8
C	1,497	683	51.1
D	2,503	469	52.5
E	3,402	469	53.7
Bright Haines Branch Farmington Prong Prong 5 Tributary 2			
A	133	91	52.4[3]
B	509	91	52.5[2]
C	943	91	52.5[2]
Bright Haines Branch Farmington Prong Prong 10			
A	500	665	53.6
B	1,500	665	53.8
Bright Haines Branch Harrington Prong			
A	116	1,030	44.4[2]
B	1,500	1,030	45.1
C	2,500	1,030	46.2
D	3,438	1,030	46.8
E	4,466	1,432	50.4
F	5,516	1,432	50.5
G	6,494	1,432	50.7
H	7,497	1,432	50.9
I	8,507	1,432	51.8
J	9,501	1,432	52.3
K	10,998	916	52.9
L	12,500	916	53.6
M	14,001	366	54.7
N	15,411	366	55.0

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Bright Haines Branch Harrington Prong Prong 7			
A	1,515	632	52.6[2]
B	2,504	632	53.7
C	3,500	410	54.4
Bright Haines Branch Harrington Prong Prong 8			
A	1,500	146	52.6[2]
Brownsville Branch			
A	1,017	768	48.7[2]
B	1,500	768	48.7[2]
C	2,500	768	48.7[2]
D	3,297	768	49.7
E	4,539	766	52.4
F	5,517	766	53.2
G	7,005	766	54.9
H	8,552	638	56.6
I	9,500	638	57.6
J	10,500	638	58.5
K	11,500	638	59.2
Cat Tail Branch			
A	1,042	1,654	35.6[2]
B	1,527	1,654	35.6[2]
C	2,537	1,654	35.8
D	4,006	1,251	36.7
E	5,025	1,251	37.8
F	6,000	1,251	38.2
G	7,511	1,251	39.5
H	8,505	1,251	39.9
I	9,540	1,251	40.7
J	10,534	1,251	41.2
K	11,250	1,251	41.7
L	12,126	1,467	44.1
M	13,000	1,467	44.4
N	13,988	1,467	44.7
O	14,999	1,467	46.2
P	16,012	1,467	47.2
Q	17,023	1,467	47.9
R	18,047	1,068	48.7

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Cat Tail Branch (continued)			
S	18,967	1,068	48.9
T	19,683	1,068	50.2
U	20,458	1,068	50.8
V	21,617	786	51.7
W	22,492	786	52.8
X	23,504	786	54.2
Y	24,479	786	55.1
Cat Tail Branch Prong 8			
A	456	532	48.4[3]
B	1,994	532	49.6
C	3,003	532	51.1
D	4,390	532	53.1
E	5,494	364	54.2
Grambull Branch			
A	516	216	50.3[3]
B	1,500	216	50.4
C	2,500	216	51.7
Green Branch			
AO	23,367	922	56.3
AP	24,500	922	56.7
AQ	25,509	922	57.2
AR	26,508	922	57.4
AS	27,508	638	57.7
AT	28,500	638	58.3
AU	29,516	415	58.8
Green Branch Prong 17			
A	342	359	56.2[2]
B	1,308	359	57.6
C	2,402	125	57.8
D	3,275	125	58.0
E	4,003	125	58.9
Green Branch Prong 17 Tributary 1			
A	164	86	57.7[2]
B	756	86	58.7
C	1,171	86	58.8
D	1,804	86	59.8
E	2,393	86	59.8

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Green Branch Prong 20			
A	234	287	57.6[2]
B	1,508	287	57.6[2]
Horsepen Arm			
AA	15,498	610	58.8
AB	16,571	570	59.3
AC	17,491	570	59.9
AD	18,633	803	60.6
AE	19,500	804	60.9
AF	20,994	528	61.4
AG	22,488	528	63.1
AH	23,481	528	63.3
AI	24,519	528	63.5
AJ	25,502	528	63.9
AK	26,490	528	64.8
Horsepen Arm Branch Prong 4			
A	1,883	569	56.0
B	2,282	569	56.1
Ingram Branch			
A	3,961	503	42.9
B	5,018	503	45.1
C	6,011	561	47.3
D	7,100	561	50.2
E	8,020	432	50.4
F	9,000	432	51.0
G	10,016	432	51.9
H	10,996	432	52.7
I	11,991	400	53.7
J	12,495	400	54
K	13,489	400	56.7
L	14,524	400	56.9
M	15,829	527	60.2
N	16,940	527	60.4
Ingram Branch Prong 2			
A	503	274	53.4[2]
B	1,362	274	53.5
C	2,000	274	54.9
D	2,473	274	55.2

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Ingram Branch Prong 2 (continued)			
E	3,518	274	56.6
F	4,448	274	57.4
Point Branch Main			
A	138	731	41.9[2]
B	1,022	731	41.9[2]
C	2,000	731	42.2
D	2,918	731	43.7
E	3,608	731	47.4
F	4,500	731	48.1
G	5,446	577	49.8
H	6,511	577	52.1
I	7,500	577	52.5
J	8,500	577	52.9
K	9,495	505	53.5
L	10,500	505	53.9
Prospect Branch			
A	237	733	41.9[2]
B	1,005	733	43.1
C	2,000	733	45.2
D	3,000	733	47.0
E	4,000	849	50.5
F	5,000	849	50.5
G	6,021	849	50.7
H	7,000	849	50.9
I	8,030	786	52.3
J	9,020	786	52.4
K	10,000	786	52.6
L	10,865	548	52.7
Quarter Branch			
A	558	511	35.5[2]
B	2,000	511	35.5[2]
C	3,000	511	35.5[2]
D	4,000	511	36.8
E	4,985	787	38.0
F	6,022	1,009	42.1
G	7,000	1,009	42.5
H	8,000	1,009	43.0

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Quarter Branch (continued)			
I	9,000	1,009	43.9
J	10,000	1,009	45.0
K	10,490	1,009	45.9
Quarter Branch Prong 3			
A	516	218	42.0[2]
B	1,975	218	43.7
C	3,000	218	45.1
Saulsbury Creek			
A	481	1,361	36.3[2]
B	1,485	1,361	36.8
C	2,848	1,361	39.7
D	4,011	1,361	41.4
E	5,478	1,840	42.9
F	6,500	1,006	44.9
G	7,480	1,053	45.6
H	8,496	991	46.6
I	9,496	991	48.0
J	10,500	816	49.0
K	11,493	816	49.9
L	12,500	816	51.2
Saulsbury Creek Prong 2			
A	163	798	44.8[3]
B	1,039	798	45.8
C	1,997	970	47.9
D	2,863	899	48.7
E	3,539	899	50.1
F	4,385	899	51.5
Saulsbury Creek Prong 2 Tributary 2			
A	193	182	51.7[2]
Saulsbury Creek Prong 2 Tributary 3			
A	179	96	51.8[3]
Saulsbury Creek Prong 3			
A	143	214	45.1[2]
Saulsbury Creek Prong 8			
A	264	78	52.1[2]

TABLE 8B – LIMITED DETAILED FLOOD HAZARD DATA - continued			
Cross Section	Stream Station[1]	Flood Discharge (cfs)	1-percent-annual-chance Water Surface Elevation (feet NAVD 88)
Saulsbury Creek Prong 9			
A	647	243	52.1[2]
Tomahawk Branch			
A	500	513	41.0[2]
B	1,500	513	41.0[2]
C	2,520	485	41.0[2]
D	3,523	485	42.6
E	4,500	460	44.2
F	5,478	460	48.4
G	6,537	524	49.5
H	7,489	524	51.6
I	8,495	524	53.4
J	9,002	299	55.9
K	9,998	299	56.0

[1] Distance from mouth
[2] Includes backwater effects
[3] Includes flooding controlled by effects

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below the frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain elevation, description, and /or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Coastal Analysis

July 7, 2014 Countywide Revision

Coastal analysis, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Users of the FIRM should be aware that coastal flood elevations are provided in Table 9, “Summary of Coastal Stillwater Elevations” table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Development along the coast of Kent County is limited to six small isolated areas: Woodland Beach, Pickering Beach, Kitts Hummock, Bowers Beach, South Bowers Beach, and Big Stone Beach. The entire coastline is comprised of a small dune whose elevation varies from four feet to more than nine feet North American Vertical Datum of 1988 (NAVD 88), with the above mentioned areas of development generally situated on the higher ground. Behind the dune, the ground slopes down to large areas of swamp and marshland. Most of this area in the northern half of the county is part of the Bombay Hook National Wildlife Refuge. Much of the area in the southern part of the county is within the Ted Harvey State Wildlife Area.

An analysis was performed to establish the frequency peak elevation relationships for coastal flooding in Kent County. The FEMA, Region III office, initiated a study in 2008 to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The study replaces outdated coastal storm surge stillwater elevations for all FIS reports in the study area, including Kent County, DE, and serves as the basis for updated FIRMs. Study efforts were initiated in 2008 and concluded in 2012.

The storm surge study was conducted for FEMA by the USACE and its project partners under Project HSFE03-06-X-0023, "NFIP Coastal Storm Surge Model for Region III" and Project HSFE03-09-X-1108, "Phase II Coastal Storm Surge Model for FEMA Region III". The work was performed by the Coastal Processes Branch (HF-C) of the Flood and Storm Protection Division (HF), U.S. Army Engineer Research and Development Center – Coastal & Hydraulics Laboratory (ERDC-CHL).

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics (Luettich et. al, 2008). ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating Waves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (USACE, 2012.). The resulting model system is typically referred to as SWAN+ADCIRC (USACE, 2012). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from three major flood events for the Region III domain: Hurricane Isabel, Hurricane Ernesto, and extratropical storm Ida. Model skill was accessed by quantitative comparison of model output to wind, wave, water level and high water mark observations.

The tidal surge in Delaware Bay affects the entire 32 miles on Kent County coastline. The southern two thirds of the coastline, from the Leipsic River southward, is more prone to damaging wave action during high wind events due to the significant fetch over which winds can operate. From the Leipsic River northward, the Delaware Bay narrows considerably as it converges with the Delaware River. In this area, the fetch over which winds can operate for wave generation is significantly less.

The storm-surge elevations for the 10-, 2-, 1-, and .2- percent annual chance floods were determined for Delaware Bay and are shown in Table 9, "Summary of Coastal Stillwater Elevations." The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects.

TABLE 9 - SUMMARY OF COASTAL STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
DELAWARE BAY Entire shoreline within county limits	7.0-7.5	8.2-8.8	8.7- 9.5	10.6 -11.7

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS, 1977). This method is based on three major concepts. First, depth-limited waves in shallow water reach maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in NAS Report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

This coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave height analysis and wave runup analysis.

Wave heights were computed across transects that were located along the coastal areas of Kent County, as illustrated on the FIRMs. The transects were laid out with consideration given to existing transect locations and to the physical and cultural characteristics of the land so that they would closely represent conditions in the locality.

Each transect was taken perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The stillwater elevations for a 1% annual chance event were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the Zone VE (area with velocity wave action) was computed at each transect. Along the open coast, the Zone VE designation applies to all areas seaward of the landward toe of the primary frontal dune system. The landward toe of the primary frontal dune is defined as the point where the ground profile changes from relatively steep to relatively mild.

Dune erosion was taken into account along the Delaware Bay coastline. A review of the geology and shoreline type in Kent County was made to determine the applicability of standard erosion methods, and FEMA's standard erosion methodology for coastal areas having primary frontal dunes, referred to as the "540 rule," was used (FEMA, 2007a). This methodology first evaluates the dune's cross-sectional profile to determine whether the dune has a reservoir of material that is greater or less than 540 square feet. If the reservoir is greater than 540 square feet, the "retreat" erosion method is employed and approximately 540 square feet of the dune is eroded using a standardized eroded profile, as specified in FEMA guidelines. If the reservoir is less than 540 square feet, the "remove" erosion method is employed where the dune is removed for subsequent analysis, again using a standard eroded profile. The storm surge study provided the return period stillwater elevations required for erosion analyses. Each cross-shore transect was analyzed for erosion, when applicable.

Wave height calculation methodologies used in this flood study are described in the FEMA guidance for coastal mapping (FEMA, 2007a). Wave setup results in an increased water level at the shoreline due to the breaking of waves and transfer of momentum to the water column during hurricanes and severe storms. For the Kent County study, wave setup was determined directly from the coupled wave and storm surge model. The total stillwater elevation (SWEL) with wave setup was then used for simulations of inland wave propagation conducted using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model Version 4.0 (FEMA, 2007b). WHAFIS is a one-dimensional model that was applied to each transect in the study area. The model uses the specified SWEL, the computed wave setup, and the starting wave conditions as input. Simulations of wave transformations were then conducted with WHAFIS taking into account the storm-induced erosion and overland features of each transect. Output from the model includes the combined SWEL and wave height along each cross-shore transect allowing for the establishment of base flood elevations (BFEs) and flood zones from the shoreline to points inland within the study area.

Wave runup is defined as the maximum vertical extent of wave uprush on a beach or structure. FEMA's 2007 Guidelines and Specifications require the 2% wave runup level be computed for the coastal feature being evaluated (cliff, coastal bluff, dune, or structure) (FEMA, 2007a). The 2% runup level is the highest 2 percent of wave runup affecting the shoreline during the 1-percent-annual-chance flood event. Each transect defined within the Region III study area was evaluated for the applicability of wave runup, and if necessary, the appropriate runup methodology was selected and applied to each transect. Runup elevations were then compared to WHAFIS results to determine the dominant process affecting BFEs and associated flood hazard levels. Based on wave runup rates, wave overtopping was computed, where applicable, following the FEMA 2007

Guidelines and Specifications. In Kent County, no transects required runup methodology to be applied.

Computed controlling wave heights at the shoreline range from 6.22 feet at the northern end of the county where the fetch is short to 6.86 feet at the southern end where the fetch is longer. The corresponding wave elevation at the shoreline varies from 13.1 feet NAVD 88 at the northern end to 14.1 feet NAVD 88 at the southern end. The dune along the coast serves to reduce wave height transmitted inland, but the large areas of low-lying marshes which are inundated by the tidal surge allow regeneration of the waves as they proceed inland. In general, the relatively shallow depth of water in the marshes along with the energy dissipating effects of vegetation allows only minor regeneration of the waves.

Figure 2, "Transect Location Map," illustrates the location of each transect. Along each transect, wave envelopes were computed considering the combined effects of changes in ground elevation, vegetation and physical features. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the aerial extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergoes major changes. The transect data for the county are presented in Table 10, "Transect Descriptions," which describes the location of each transect. In addition, Table 10, provides the 1-percent annual chance stillwater with wave setup and the maximum wave crest elevations for each transect along coastline. In Table 11, "Transect Data," the flood hazard zone and base flood elevations for each transect flooding source is provided, along with the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations for the respective flooding source.

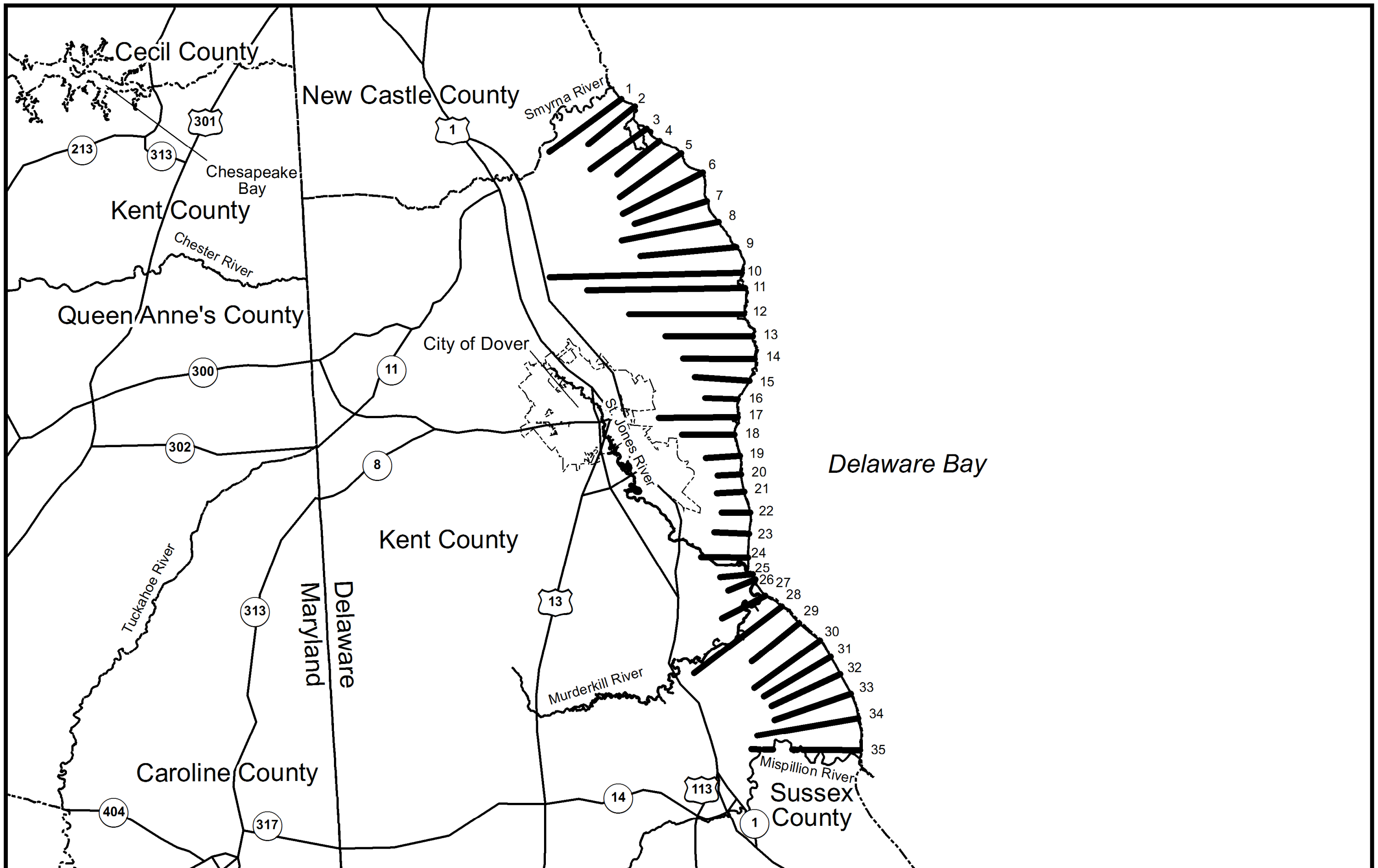

Figure 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DELAWARE AND INCORPORATED AREAS

Approximate Scale

0 1 2 4 6 8 Miles

N

TRANSECT LOCATION MAP

TABLE 10 - TRANSECT DESCRIPTIONS

TRANSECT	LOCATION	ELEVATION (ft NAVD 88) 1-PERCENT ANNUAL CHANCE STILLWATER (at shoreline)	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
1	From the Delaware Bay shoreline, approximately 3300 feet southeast of the mouth of the Smyrna River, inland across Route 1, starting at 39.3587° N, 75.503998° W	8.7	13.10
2	From the Delaware Bay shoreline, approximately 6500 feet southeast of the mouth of the Smyrna River, inland across Route 1, starting at 39.354401° N, 75.493599° W	8.7	13.07
3	From the Delaware Bay shoreline, approximately 2000 feet north of Pierson Cove (at Persimmon Hummock), inland across Smyrna Leipsic Road, starting at 39.340302° N, 75.483704° W	8.7	13.08
4	From the Delaware Bay shoreline, approximately at feet of Pierson Cove, inland across Chappel Yeatman Road, starting at 39.333698° N, 75.474602° W	8.7	13.08
5	From the Delaware Bay shoreline, approximately 6600 feet north of Bombay Hook Point, inland across Road 326, starting at 39.3251° N, 75.4561° W	8.7	13.01
6	From the Delaware Bay shoreline, approximately at feet of Bombay Hook Point, inland across Smyrna Leipsic Road, starting at 39.313099° N, 75.438599° W	8.7	12.99
7	From the Delaware Bay shoreline, approximately 400 feet south of Sluice Ditch, inland across Route 9, starting at 39.295601° N, 75.435402° W	8.7	13.15
8	From the Delaware Bay shoreline, approximately 5700 feet southeast of Sluice Ditch, inland across Route 1, starting at 39.282799° N, 75.425903° W	8.7	13.14
9	From the Delaware Bay shoreline, approximately 7600 feet north of the Leipsic River, inland across Route 1, starting at 39.266998° N, -75.411797° W	8.7	13.12

TABLE 10 - TRANSECT DESCRIPTIONS- Continued

TRANSECT	LOCATION	ELEVATION (ft NAVD 88) 1-PERCENT ANNUAL CHANCE STILLWATER (at shoreline)	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
10	From the Delaware Bay shoreline, approximately 1800 feet north of the Leipsic River, inland across Route 1, starting at 39.251202° N, 75.407501° W	8.8	13.28
11	From the Delaware Bay shoreline, approximately 100 feet south of the mouth of the Leipsic River, inland across Route 1, starting at 39.241798° N, 75.404701° W	8.7	13.21
12	From the Delaware Bay shoreline, approximately 500 feet north of the mouth of the Simon River, inland across Route 1, starting at 39.225601° N, 75.406303° W	8.8	13.34
13	From the Delaware Bay shoreline, approximately 4300 feet southeast of the mouth of the Simon River, inland across Route 1, starting at 39.2117° N, 75.398499° W	8.8	13.32
14	From the Delaware Bay shoreline, approximately 2000 feet north of the mouth of the Mahon River, inland across Route 1, starting at 39.197701° N, 75.397102° W	8.9	13.41
15	From the Delaware Bay shoreline, approximately 2300 feet south of the mouth of the Mahon River, inland across White Oak Road, starting at 39.184299° N, 75.401299° W	8.9	13.47
16	From the Delaware Bay shoreline, approximately 4700 feet north of the mouth of the Little River, inland across Little River, starting at 39.172901° N, 75.410599° W	9	13.64
17	From the Delaware Bay shoreline, approximately 600 feet north of the mouth of the Little River, inland across Little River, starting at 39.161701° N, 75.410599° W	9	13.64
18	From the Delaware Bay shoreline, approximately 2700 feet south of the mouth of the Little River, inland across Pipe Elm Branch, starting at 39.150799° N, 75.4132° W	9.2	13.83

TABLE 10 - TRANSECT DESCRIPTIONS- Continued

TRANSECT	LOCATION	ELEVATION (ft NAVD 88) 1-PERCENT ANNUAL CHANCE STILLWATER (at shoreline)	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
19	From the Delaware Bay shoreline, approximately at feet of the end of Pickering Beach Road, inland across Dover Air Force Base, starting at 39.137699° N, 75.408997° W	9.1	13.72
20	From the Delaware Bay shoreline, approximately 1000 feet south of Lewis Ditch, inland across Dover Air Force Base, starting at 39.126301° N, 75.408203° W	9.2	13.92
21	From the Delaware Bay shoreline, approximately at feet of Sand Ditch, inland across Dover Air Force Base, starting at 39.115299° N, 75.405701° W	9.2	13.99
22	From the Delaware Bay shoreline, approximately at feet of the end of Kitts Hummock Road, inland across St. Jones River, starting at 39.1026° N, 75.400902° W	9.3	14.00
23	From the Delaware Bay shoreline, approximately 8300 feet north of the mouth of the St. Jones River, inland across Route 10, starting at 39.0896° N, 75.401703° W	9.4	14.26
24	From the Delaware Bay shoreline, approximately 2900 feet north of the mouth of the St. Jones River, inland across Route 1, starting at 39.074799° N, 75.402496° W	9.5	14.44
25	From the Delaware Bay shoreline, approximately 300 feet south of the mouth of the St. Jones River, inland across Route 1, starting at 39.064499° N, 75.398697° W	9.5	14.42
26	From the Delaware Bay shoreline, approximately 700 feet north of the mouth of the Murderkill River, inland across to Route 1, starting at 39.0611° N, 75.3965° W	9.5	14.43
27	From the Delaware Bay shoreline, approximately 3300 feet south of the mouth of the Murderkill River, inland across Spring Creek, starting at 39.0509° N, 75.388702° W	9.5	14.43

TABLE 10 - TRANSECT DESCRIPTIONS- Continued

TRANSECT	LOCATION	ELEVATION (ft NAVD 88) 1-PERCENT ANNUAL CHANCE STILLWATER (at shoreline)	MAXIMUM 1-PERCENT ANNUAL CHANCE WAVE CREST
28	From the Delaware Bay shoreline, approximately 1500 feet northwest of the mouth of Brockonbridge Gut, inland across Browns Branch, starting at 39.0443° N, 75.375603° W	9.3	14.17
29	From the Delaware Bay shoreline, approximately 1400 feet northwest of Bennetts Pier Road, inland across to Route 1, starting at 39.0341° N, 75.361603° W	9.2	14.00
30	From the Delaware Bay shoreline, approximately 4800 feet southeast of Bennetts Pier Road, inland across Thompsonville Road, starting at 39.0233° N, 75.3451° W	9	13.78
31	From the Delaware Bay shoreline, approximately 9100 feet southeast of Bennetts Pier Road, inland across to Tolbert Road, starting at 39.0131° N, 75.336502° W	9	13.74
32	From the Delaware Bay shoreline, approximately 700 feet northwest of Big Stone Beach Road, inland across to Tolbert Road, starting at 39.002499° N, 75.328796° W	9	13.76
33	From the Delaware Bay shoreline, approximately 4400 feet southeast of Big Stone Beach Road, inland across to Beaverdam Branch, starting at 38.990299° N, 75.320297° W	9	13.76
34	From the Delaware Bay shoreline, approximately 8600 feet north of the mouth of the Mispillion River, inland across to Route 1, starting at 38.9753° N, 75.314499° W	9.1	13.89
35	From the Delaware Bay shoreline, approximately 1300 feet north of the mouth of the Mispillion River, inland across to Route 1, starting at 38.9552° N, 75.313103° W	9.3	14.07

TABLE 11 - TRANSECT DATA

Flood Source	Transect	Coordinates	Starting Wave Conditions for the 1% Annual Chance: Significant Wave Height H_s (ft)	Starting Wave Conditions for the 1% Annual Chance: Peak Wave Period T_p (sec)	Starting Stillwater Elevations (ft NAVD88) / Range of Stillwater Elevations* (ft NAVD88): 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Delaware Bay	1	N 39.358923 W 75.503845	6.5	5.4	7.2 5.0 -7.2	8.3 6.2 - 8.3	8.7 6.6-8.7	10.8 8.8-10.8
Delaware Bay	2	N 39.354343 W -75.493095	6.6	5.4	7.2 5.0 -7.3	8.2 6.1-8.3	8.7 6.5-8.7	10.7 8.8-10.9
Delaware Bay	3	N 39.340570 W 75.483352	6.4	5.4	7.2 5.1-7.2	8.2 6.2-8.2	8.7 6.6-8.7	10.8 8.8-10.8
Delaware Bay	4	N 39.333058 W 75.472993	6.3	5.5	7.2 5.7 -7.3	8.2 6.7- 8.2	8.7 7.1-8.7	10.7 9.3-10.7
Delaware Bay	5	N 39.325230 W 75.455936	6.1	5.3	7.2 6.3- 7.2	8.2 7.2-8.2	8.7 7.7-8.7	10.7 9.8-10.7
Delaware Bay	6	N 39.313223 W 75.438396	6.6	5.5	7.2 6.5- 7.2	8.1 7.4-8.1	8.7 7.8-8.7	10.6 9.8-10.9
Delaware Bay	7	N 39.295651 W 75.435174	7.3	6.0	7.2 6.5-7.2	8.2 7.5-8.3	8.7 8.02-8.7	10.8 10.3-10.8
Delaware Bay	8	N 39.282783 W 75.425787	7.1	6.0	7.2 6.5-7.3	8.2 7.4-8.2	8.7 7.8-8.7	10.7 10.0-10.7
Delaware Bay	9	N 39.267054 W 75.411371	7.5	6.3	7.2 6.5-7.3	8.2 7.4-8.2	8.7 7.8-8.7	10.6 10.0-10.7
Delaware Bay	10	N 39.251221 W 75.407038	8.5	6.2	7.3 6.5-7.3	8.3 7.4-8.3	8.8 7.8-8.8	10.8 10.0-10.8

* For Transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and the range.

TABLE 11 - TRANSECT DATA- Continued

Flood Source	Transect	Coordinates	Starting Wave Conditions for the 1% Annual Chance: Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	Starting Stillwater Elevations (ft NAVD88) / Range of Stillwater Elevations* (ft NAVD88): 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Delaware Bay	11	N 39.241783 W 75.404189	8.6	6.2	7.3 6.5-7.3	8.2 7.4-8.3	8.7 7.8-8.8	10.7 9.9-10.7
Delaware Bay	12	N 39.225596 W 75.405529	8.4	6.3	7.4 6.5-7.4	8.3 7.4-8.3	8.8 7.8-8.9	11.0 9.9-11.0
Delaware Bay	13	N 39.211736 W 75.398371	8.6	6.4	7.3 6.5-7.4	8.2 7.4- 8.3	8.8 7.8-8.9	11.0 10.0-11.0
Delaware Bay	14	N 39.197729 W 75.396661	9.0	6.4	7.4 7.0-7.4	8.3 7.6- 8.4	8.9 8.0-8.9	11.1 10.2-11.3
Delaware Bay	15	N 39.184338 W 75.401293	8.1	6.4	7.4 7.4-7.6	8.3 8.3-8.6	8.9 8.8-9.0	11.3 11.0-12.1
Delaware Bay	16	N 39.172888 W 75.410505	7.3	6.5	7.5 7.5-7.9	8.4 8.4-8.9	9.0 9.0-9.6	11.5 11.5-12.3
Delaware Bay	17	N 39.161748 W 75.410506	7.5	6.5	7.5 7.5-7.9	8.4 8.4-8.9	9.0 9.0-9.6	11.5 11.5-12.3
Delaware Bay	18	N 39.150805 W 75.413152	6.9	6.5	7.5 7.5-7.9	8.5 8.5-8.9	9.2 9.2- 9.6	11.6 11.6-12.3
Delaware Bay	19	N 39.137725 W 75.408963	7.5	6.6	7.4 7.4-8.0	8.4 8.4-9.0	9.1 8.9-9.7	11.5 11.4-12.2
Delaware Bay	20	N 39.115296 W 75.407921	7.4	6.6	7.4 7.4-7.8	8.5 8.4-8.9	9.2 9.0-9.7	11.6 11.5-12.0

* For Transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and the range.

TABLE 11 - TRANSECT DATA- Continued

			Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88)			
Flood Source	Transect	Coordinates	Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Delaware Bay	21	N 39.115375 W 75.405317	7.2	6.8	7.4 7.2-7.7	8.4 8.2 - 8.9	9.2 8.7-9.6	11.6 10.9-12.0
Delaware Bay	22	N 39.102619 W 75.400547	6.6	6.7	7.4 7.0-7.8	8.5 7.9-8.9	9.3 8.2-9.7	11.5 10.4- 12.0
Delaware Bay	23	N 39.089564 W 75.401549	6.4	6.7	7.4 7.0-7.7	8.6 7.9-9.0	9.4 8.3-9.7	11.6 10.3-12.0
Delaware Bay	24	N 39.074750 W 75.402310	6.4	6.7	7.5 7.1-7.7	8.8 8.0-8.9	9.5 8.4-9.7	11.7 10.5-11.8
Delaware Bay	25	N 39.064327 W 75.398472	6.5	6.8	7.5 7.4-7.9	8.7 8.4-9.1	9.5 8.9-9.8	11.6 10.8-11.8
Delaware Bay	26	N 39.061090 W 75.396513	6.6	6.9	7.5 7.4-7.9	8.7 8.5-9.1	9.5 9.1-9.9	11.6 11.2-11.8
Delaware Bay	27	N 39.051057 W 75.388438	8.0	7.0	7.5 7.3-7.7	8.8 8.3-8.8	9.5 8.7-9.5	11.4 10.3-11.4
Delaware Bay	28	N 39.044404 W 75.375284	8.7	7.0	7.4 7.2-7.7	8.6 8.4-9.0	9.3 8.7-9.7	11.2 10.2-11.4
Delaware Bay	29	N 39.034390 W 75.361340	8.0	7.1	7.3 7.3-7.7	8.5 8.5-9.0	9.3 8.7-9.7	11.0 10.5-11.8
Delaware Bay	30	N 39.023417 W 75.344605	7.6	7.2	7.2 7.2-7.8	8.3 8.3-9.1	9.0 9.0-9.8	10.7 10.7-11.8
Delaware Bay	31	N 39.013168 W 75.336249	7.8	7.2	7.1 7.1-7.6	8.3 8.3-9.0	9.0 9.0-9.8	10.8 10.8-11.6

* For Transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and the range.

TABLE 11 - TRANSECT DATA- Continued

			Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88)			
Flood Source	Transect	Coordinates	Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Delaware Bay	32	N 39.002467 W 75.328587	8.4	7.3	7.1 7.1-7.6	8.3 8.3-8.9	9.0 9.0-9.5	10.7 10.7-11.2
Delaware Bay	33	N 38.990310 W 75.319927	7.8	7.4	7.0 7.0-7.5	8.3 8.3-8.9	9.0 9.0-9.5	10.7 10.7-11.2
Delaware Bay	34	N 38.975394 W 75.314335	7.4	6.3	7.1 7.1-7.6	8.4 8.4-8.9	9.1 9.1-9.5	10.7 10.7-11.1
Delaware Bay	35	N 38.955128 W 75.312712	5.9	7.3	7.1 7.1-7.6	8.5 8.5-8.9	9.3 9.2-9.5	10.9 10.9-11.3

* For Transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and the range.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE, 1975). The 3-foot wave has been determined to be the minimum size wave capable of causing major damage to conventional wood frame of brick veneer structures. The one exception to the 3-foot wave criteria is where a primary frontal dune exists. The limit the coastal high hazard area then becomes the landward toe of the primary frontal dune or where a 3-foot or greater breaking wave exists, whichever is most landward. The coastal high hazard zone is depicted on the FIRMs as Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet. Zone AE is depicted on the FIRMs where the delineated flood hazard includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 3, “Transect Schematic”.

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE (see Figure 3).

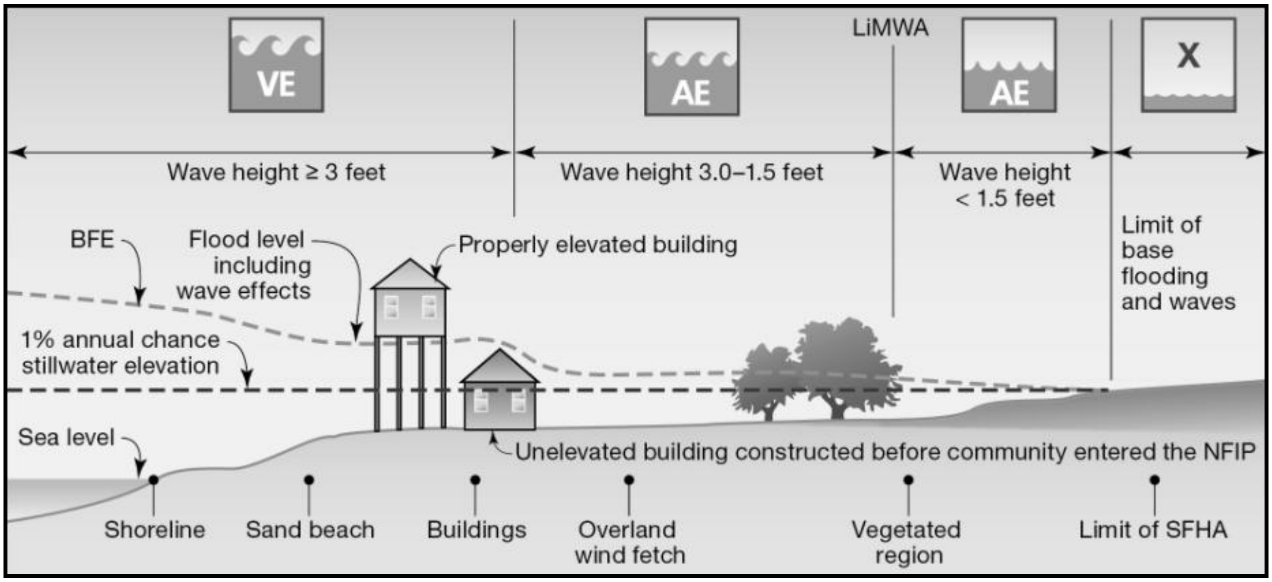

FIGURE 3: TRANSECT SCHEMATIC

3.4 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the Datum NAVD 88, many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the county must, therefore, be referenced to NAVD 88. It is important to note that adjacent counties may be referenced to NGVD 29. This may result in differences in base flood elevations (BFEs) across the county boundaries between the counties.

The average datum shift from NGVD 29 to NAVD 88 for Kent County used was -0.8 feet.

For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
http://www.ngs.noaa.gov/

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, and Floodway Data Tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 1-percent and 0.2-percent annual chance floodplains have been delineated using the flood elevations determined at each cross section. For the streams studied by approximate methods, only the 1 percent annual chance floodplain boundary is shown on the FIRM.

The 1 percent and 0.2 percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1 percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2 percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1 percent and 0.2 percent annual chance floodplain boundaries are close together, only the 1 percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The Initial Countywide FIS

For the May 5, 2003 countywide FIS, flood boundaries were determined with the use of an Arc/Info software application developed by the USACE, Philadelphia District. The computer-generated floodplain boundary check plots were printed, reviewed for accuracy noting any necessary changes. Minor adjustments to the digital floodplain boundaries, including any necessary edge matching, were made in the Arc/Info environment. Locations of the floodway boundaries were marked only at the cross sections, the floodway was hand drawn on the preliminary printouts of the maps connecting the computer-generated markers. Since the cross sections are relatively closely spaced in this study producing many floodway markers (made possible by using a DTM as a source for topographic information), delineation of the floodway was straightforward and required minimal engineering judgment. The floodway was integrated into the digital database using Arc/Info software.

July 7, 2014 Countywide Revision

For July 7, 2014 revision, riverine flood boundaries were determined with the use of ArcMap 10.0 Software (ESRI, 2010). The computer-generated floodplain boundaries were reviewed for accuracy noting any necessary changes. Minor adjustments to the digital floodplain boundaries, including any necessary edge matching, were made in the ArcMap environment. The terrain source used to delineate the floodplain boundaries for both riverine and coastal analysis was 2007 LiDAR obtained from the Delaware DataMIL (Delaware Geological Survey, 2010).

This Countywide Revision

For this revision, the 1% annual chance riverine flood boundaries were delineated using flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic data acquired using airborne Light Detection and Ranging (LiDAR). The computer generated 1-percent annual chance floodplain boundaries were manually reviewed for accuracy and minor adjustments were made in ArcMap environment. The LiDAR terrain source used was 2007 LiDAR data obtained from NOAA's Digital Coast (http://coast.noaa.gov/digitalcoast/).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections in Table 12, “Floodway Data.” The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The floodway for Brown's Branch South, Isaac Branch, Leipsic River, Mill Creek, Puncheon Branch, and Tidbury Creek were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream studied in detail.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 12 for certain downstream cross sections of Green's Branch, Mill Creek, Puncheon Branch, St. Jones River, and Tidbury Creek are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Tantrough Branch has a floodway that extends beyond the county boundary. The following detailed studied streams do not have computed floodways: Beaverdam Ditch, Brown's Branch North, Choptank River, Tidy Island Creek, Coursey Pond, Cow Marsh Creek, Willow Grove Prong, Culbreth Marsh Ditch, Duck Creek, Providence Creek, Green Branch, Horsepen Arm, Little River, Marshyhope Creek, McColley Pond, Morgan Branch, Penrose Branch, and Tappahanna Ditch.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 12, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

No floodways have been computed for streams studied by limited detailed methods.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4, "Floodway Schematic."

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Browns' Branch South								
A	3,216[1]	49	148	2.9	44.8	44.8	45.8	1.0
B	4,816[1]	71	207	2.1	47.4	47.4	48.2	0.8
Cahoon Branch								
A	602[2]	186	1,106	1.7	33.0	33.0	33.8	0.8
B	923[2]	194	942	2.0	33.4	33.4	34.2	0.8
C	1,442[2]	296	1,744	1.1	33.8	33.8	34.9	1.0
D	2,137[2]	211	837	2.2	34.4	34.4	35.4	1.0
E-BA*								
Fork Branch								
A	385[3]	399	3,200	0.8	26.8	26.8	27.8	1.0
B	783[3]	470	3,863	0.7	26.9	26.9	27.9	1.0
C	1,454[3]	388	2,779	0.9	27.0	27.0	28.0	1.0
D	1,996[3]	305	2,148	1.2	27.2	27.2	28.1	0.9
E	2,188[3]	230	1,809	1.4	27.2	27.2	28.2	1.0
F-AZ*								

[1]Feet above Route 431
[2]Feet above confluence with Maidstone Branch
[3]Feet above confluence with St. Jones River
*No floodway data computed

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

BROWN'S BRANCH SOUTH - CAHOON BRANCH - FORK BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Green's Branch								
A	-100[1]	22	72	9.4	9.3	7.8[3]	7.8	0.0
B	0[1]	26	141	4.8	9.3	8.6[3]	9.6	1.0
C	1,344[1]	25	71	9.6	12.5	12.5	12.7	0.2
D	3,344[1]	71	266	2.6	19.6	19.6	20.6	1.0
E	4,594[1]	24	122	5.6	22.1	22.1	23.1	1.0
F	4,657[1]	12	57	11.8	22.1	22.1	22.1	0.0
G	5,057[1]	45	216	3.1	24.8	24.8	24.8	0.0
H	7,050[2]	47	116	4.5	29.0	29.0	29.0	0.0
I	8,300[2]	52	179	2.9	31.5	31.5	32.5	1.0
J	8,375[2]	19	85	6.0	31.6	31.6	32.6	1.0
K	8,425[2]	19	86	6.0	33.7	33.7	33.7	0.0
L	8,725[2]	19	101	5.1	33.8	33.8	34.0	0.2
M	8,800[2]	30	119	3.8	33.9	33.9	34.2	0.3
N	8,942[2]	18	94	4.7	35.4	35.4	35.4	0.0
O	9,242[2]	36	188	2.4	35.6	35.6	35.6	0.0
P	9,308[2]	37	209	2.1	35.6	35.6	35.6	0.0

[1]Feet above Main Street
[2]Feet above confluence with Duck Creek
[3]Elevation computed without consideration of backwater effects from Duck Creek

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

GREEN'S BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Isaac Branch								
A	6,050	32[2]	*	*	11.5	11.5	11.6	0.1
B	8,050	280[2]	*	*	11.5	11.5	11.6	0.1
C	9,050	400[2]	*	*	11.5	11.5	11.6	0.1
D	10,900	64	222	6.9	12.0	12.0	13.0	1.0
E	12,380	139	616	2.5	15.9	15.9	16.6	0.7
F	14,080	174	756	2.0	17.6	17.6	18.5	0.9
G	16,080	126	674	2.3	19.3	19.3	20.2	0.9
H	17,780	234	1,042	1.5	20.7	20.7	21.7	1.0
I	18,630	28	157	9.8	22.3	22.3	23.1	0.8
J	18,714	23	200	7.7	24.2	24.2	24.5	0.3
K	18,801	22	188	8.2	25.3	25.3	25.5	0.2
L	18,930	94	814	1.9	26.4	26.4	27.4	1.0
M	18,980	94	800	1.9	26.9	26.9	27.5	0.6
N	20,200	400[2]	*	*	29.5	29.5	29.6	0.1
O	21,200	500[2]	*	*	29.5	29.5	29.6	0.1
P	22,200	375[2]	*	*	29.5	29.5	29.6	0.1
Q	23,200	370[2]	*	*	29.5	29.5	29.6	0.1
R	24,200	150[2]	*	*	29.5	29.5	29.6	0.1
Leipsic River								
A	91,140	630[2]	*	*	11.3	11.3	11.7	0.4
B	92,140	380[2]	*	*	11.3	11.3	11.7	0.4
C	93,140	420[2]	*	*	11.3	11.3	11.7	0.4
D	94,940	540[2]	*	*	11.3	11.3	11.7	0.4
E	95,925	430[2]	*	*	11.3	11.3	11.7	0.4

[1]Feet above confluence with St. Jones River
[2]Lake section: floodway boundary is edge of lake at normal pool (see Section 4.2 of text)

*Data not computed

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

ISAAC BRANCH - LEIPSIC RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Maidstone Branch								
A	208	132	1,457	3.2	26.8	26.8	27.8	1.0
B	405	430	5,504	0.9	29.3	29.3	30.3	1.0
C	734	460	5,713	0.8	29.4	29.4	30.3	0.9
D	1,028	430	5,465	0.9	29.4	29.4	30.3	0.9
E	1,329	440	5,577	0.8	29.4	29.4	30.4	1.0
F	1,633	420	5,265	0.9	29.4	29.4	30.4	1.0
G	2,217	442	5,129	0.9	29.4	29.4	30.4	1.0
H	2,476	364	3,556	1.3	29.4	29.4	30.4	1.0
I	2,654	500	5,744	0.8	29.5	29.5	30.5	1.0
J	3,007	490	5,695	0.8	29.6	29.6	30.5	0.9
K	3,296	533	5,541	0.8	29.6	29.6	30.6	1.0
L	3,777	480	5,044	0.9	29.6	29.6	30.6	1.0
M	4,147	460	4,654	1.0	29.7	29.7	30.6	0.9
N	4,620	480	4,351	1.1	29.7	29.7	30.7	1.0
O	5,067	480	4,138	1.1	29.8	29.8	30.7	0.9
P	5,575	413	3,055	1.5	29.8	29.8	30.8	1.0
Q	6,164	292	2,116	2.2	30.1	30.1	31.0	0.9
R	6,423	251	1,876	2.5	30.4	30.4	31.2	0.8
S	6,881	286	1,874	2.5	30.8	30.8	31.5	0.7
T	7,195	220	1,473	3.2	31.0	31.0	31.8	0.8
U	7,447	200	1,148	4.1	31.3	31.3	32.1	0.8
V	7,999	190	1,402	2.4	32.5	32.5	33.3	0.8
W	8,630	250	1,560	2.1	32.8	32.8	33.8	1.0
X	8,950	249	1,534	2.2	33.2	33.2	34.1	0.9
Y	9,237	301	1,709	2.0	33.6	33.6	34.4	0.8
Z	9,625	245	900	3.7	34.4	34.4	34.8	0.4
AA	9,805	270	862	3.9	34.9	34.9	35.6	0.7
AB-BD*								

[1]Feet above confluence with St. Jones River
*No floodway data computed

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

MAIDSTONE BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mill Creek								
A	14,000	40	264	3.6	7.6	7.9[3]	7.9	0.0
B	18,250	460[2]	*	*	16.9	16.9	17.0	0.1
C	19,300	31	251	3.9	18.0	18.0	19.0	1.0
D	19,350	100	377	2.6	18.2	18.2	19.1	0.9
E	21,300	143	538	1.8	19.7	19.7	20.5	0.8
F	23,300	164	584	1.7	23.6	23.6	24.6	1.0
G	24,550	10[4]	112	8.6	29.5	29.5	30.5	1.0

[1]Feet above confluence with Smyrna River
[2]Lake section: floodway boundary is edge of lake at normal pool (see Section 4.2 of text)
[3]Elevation computed without consideration of backwater effects from Delaware Bay
*Data not available

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Puncheon Branch								
A	0	179	1,233	0.9	8.2	7.8[2]	7.8	0.0
B	1,350	65	385	2.8	8.2	8.0[2]	8.1	0.1
C	2,500	39	157	7.0	9.8	9.8	10.1	0.3
D	2,630	38	365	3.0	16.3	16.3	16.3	0.0
E	2,830	101	389	2.8	16.6	16.6	16.6	0.0
F	3,080	146	734	1.5	16.6	16.6	17.1	0.5
G	3,295	45	331	3.3	16.7	16.7	17.2	0.5
H	3,645	69	464	2.3	16.9	16.9	17.9	1.0
I	3,740	75	447	2.4	17.0	17.0	18.0	1.0
J	4,540	91	487	2.2	17.2	17.2	18.2	1.0
K	5,740	55	227	4.8	18.6	18.6	19.4	0.6
L	7,190	40	225	4.9	22.8	22.8	23.7	0.9
M	7,370	17	146	7.6	24.1	24.1	25.1	1.0
N	8,400	204	1,476	0.4	26.6	26.6	27.6	1.0
O	9,560	236	1,378	0.5	26.7	26.7	27.7	1.0
P	10,930	62	275	2.4	27.0	27.0	28.0	1.0

[1]Feet above confluence with St. Jones River
[2]Elevation computed without consideration of backwater effects from Delaware Bay

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

PUNCHEON BRANCH

TABLE 12

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
St. Jones River								
A-P*								
Q	10,614	175	1,507	4.8	8.6	8.6[2]	8.6	0.0
R	10,781	325	1,946	3.7	8.6	8.6[2]	8.6	0.0
S	11,275	420	3,934	1.8	8.8	8.8	8.8	0.0
T	11,692	413	4,895	1.5	8.9	8.9	8.9	0.0
U	12,204	338	2,587	2.8	8.9	8.9	8.9	0.0
V	12,352	387	2,895	2.5	9.0	9.0	9.1	0.1
W	13,450	130	1,548	4.7	9.5	9.5	9.7	0.2
X	14,367	100	1,163	6.2	10.2	10.2	10.5	0.3
Y	14,687	101	1,343	5.4	14.2	14.2	14.2	0.0
Z	15,046	259	3,215	2.2	14.7	14.7	14.8	0.1
AA	15,401	295	3,901	1.9	15.7	15.7	16.5	0.8
AB	15,622	300	4,316	1.7	15.7	15.7	16.5	0.8
AC	15,949	340	4,706	1.5	15.8	15.8	16.6	0.8
AD	16,779	350	4,299	1.7	15.8	15.8	16.7	0.9
AE	17,005	390	2,784	2.6	15.8	15.8	16.7	0.9
AF	17,095	390	3,246	2.2	16.9	16.9	17.9	1.0
AG	17,291	352	4,914	1.5	17.0	17.0	18.0	1.0
AH	18,097	348	5,372	1.3	17.1	17.1	18.0	0.9
AI	18,368	375	5,974	1.2	17.1	17.1	18.1	1.0
AJ	18,713	541	7,305	1.0	17.1	17.1	18.1	1.0
AK	19,023	934	8,008	0.9	17.2	17.2	18.1	0.9
AL	19,498	715	10,272	0.7	18.4	18.4	18.8	0.4
AM	20,300	516	7,318	1.0	18.4	18.4	18.8	0.4

[1]Feet above limit of detailed study (limit of detailed study is approximately 2,075 feet upstream of East Lebanon Road)
[2]Elevation computed without consideration of backwater effects from Delaware Bay
*Floodway data not computed

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

ST. JONES RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
St. Jones River (continued)								
AN	21,911	473	6,491	1.1	18.4	18.4	18.8	0.4
AO	22,356	1,422	19,816	0.4	18.5	18.5	18.9	0.4
AP	22,923	115	9,508	4.6	18.3	18.3	18.7	0.4
AQ	23,023	110	10,423	4.4	19.5	19.5	20.0	0.5
AR	23,321	706	10,623	0.7	19.9	19.9	20.4	0.5
AS	24,405	1,203	17,195	0.4	19.9	19.9	20.4	0.5
AT	25,342	942	12,543	0.6	19.9	19.9	20.4	0.5
AU	26,535	620	8,400	0.9	19.9	19.9	20.4	0.5
AV	27,488	564	7,992	0.9	19.9	19.9	20.4	0.5
AW	28,966	307	4,194	1.3	20.0	20.0	20.4	0.4
AX	29,152	310	3,586	1.5	20.0	20.0	20.4	0.4
AY	29,297	340	2,455	2.2	20.0	20.0	20.4	0.4
AZ	29,770	244	1,386	4.0	20.2	20.2	20.6	0.4
BA	30,100	169	1,410	3.9	21.8	21.8	22.6	0.8
BB	31,057	300	2,699	2.0	23.0	23.0	23.8	0.8
BC	31,629	390	3,224	1.7	23.4	23.4	24.3	0.9
BD	32,635	432	3,160	1.7	24.1	24.1	25.1	1.0
BE	34,417	310	2,605	2.1	25.6	25.6	26.5	0.9
BF	35,828	490	3,928	1.4	26.7	26.7	27.6	1.0

[1]Feet above limit of detailed study (limit of detailed study is approximately 2,075 feet upstream of East Lebanon Road)

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

ST. JONES RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Stream No. 1								
A	0[1]	22	53	2.9	16.9	16.9	16.9	0.0
B	550[1]	11	36	4.2	17.8	17.8	18.3	0.5
C	599[1]	11	71	2.2	21.5	21.5	22.0	0.5
D	649[1]	34	235	0.7	21.5	21.5	22.1	0.6
Tantrough Branch								
A	3,263[2]	630[3]	1,986	0.8	15.2	15.2	15.2	0.0
B	5,960[2]	140[3]	238	3.2	15.4	15.4	15.5	0.1
C	6,580[2]	120[3]	211	3.6	17.6	17.6	18.0	0.4
D	6,719[2]	55[3]	1,872	0.4	24.0	24.0	24.0	0.0
E	9,030[2]	370[3]	2,121	0.4	24.0	24.0	24.0	0.0
F	11,140[2]	90[3]	405	1.9	24.0	24.0	24.0	0.0
G	13,470[2]	145[3]	183	4.1	26.0	26.0	26.7	0.7
H	13,568[2]	450[3]	3,853	0.2	33.8	33.8	34.7	0.9
I	16,760[2]	16,760[3]	336	0.7	33.8	33.8	34.7	0.9

[1]Feet above confluence with Mill Creek (Lake Como)
[2]Feet above U.S. Route 113
[3]Portion of floodway extends outside county boundary

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

FLOODWAY DATA

STREAM NO. 1 - TANTROUGH BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tidbury Creek								
A	8,000	269	2,472	0.8	8.6	7.8[3]	8.8	1.0
B	9,300	341	3,701	0.6	9.5	9.5	10.5	1.0
C	10,500	163	1,527	1.4	9.7	9.7	10.7	1.0
D	11,350	262	1,838	1.1	13.0	13.0	14.0	1.0
E	12,050	266	2,088	1.0	13.2	13.2	14.2	1.0
F	13,550	148	1,008	2.0	13.4	13.4	14.4	1.0
G	14,390	210	1,626	1.3	16.6	16.6	17.6	1.0
H	15,140	252	1,612	1.3	16.8	16.8	17.8	1.0
I	16,600	320[2]	*	*	19.9	19.9	20.1	0.2
J	18,100	260[2]	*	*	19.9	19.9	20.1	0.2
K	19,600	312[2]	*	*	19.9	19.9	20.1	0.2
L	20,600	125	*	*	19.9	19.9	20.1	0.2
M	21,750	112	349	4.8	21.3	21.3	22.3	1.0
N	22,220	235	1,747	1.0	24.6	24.6	25.6	1.0
O	22,710	173	2,374	0.7	31.9	31.9	32.9	1.0

[1]Feet above confluence with Delaware Bay
[2]Lake section: floodway boundary is edge of lake at normal pool (see Section 4.2 of text)
[3]Elevation computed without consideration of backwater effects from Delaware Bay
*Data not available

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE AND INCORPORATED AREAS

FLOODWAY DATA

TIDBURY CREEK

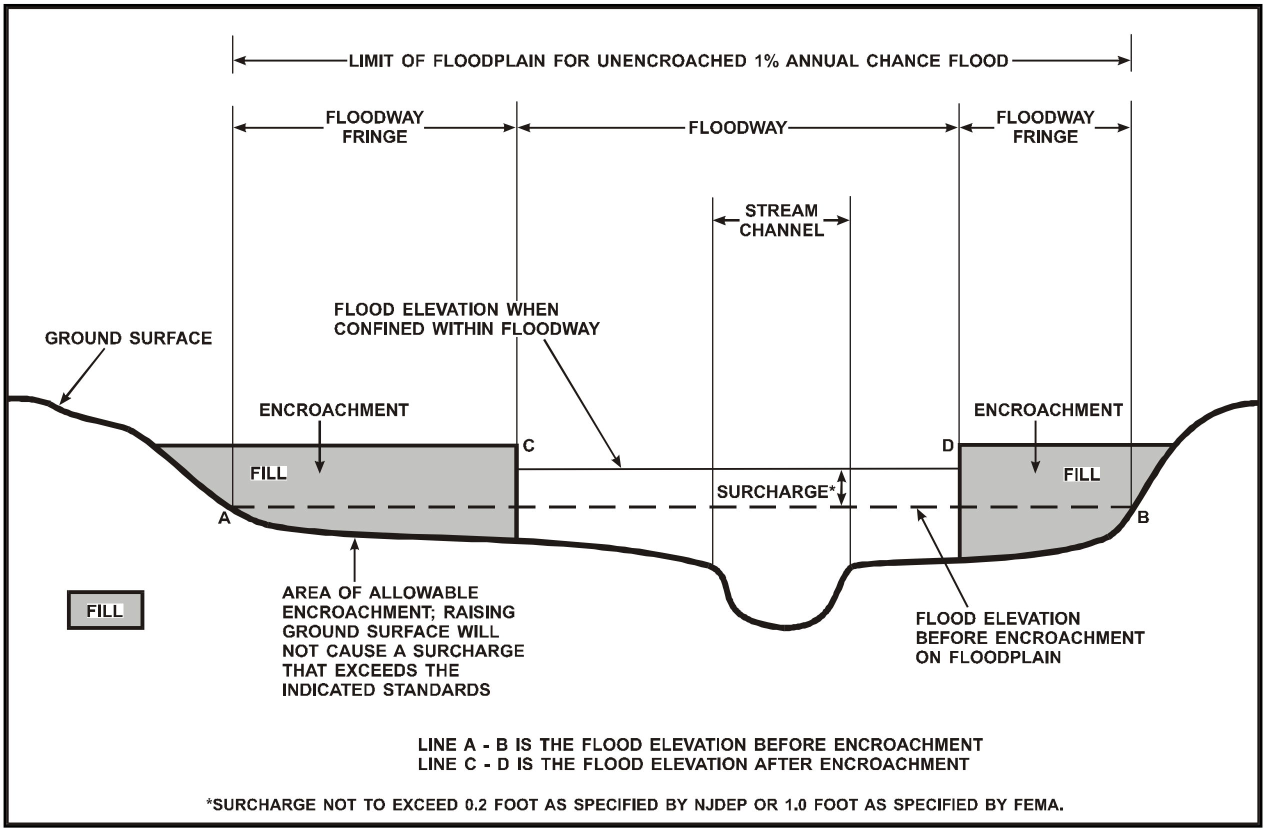

Figure 4: FLOODWAY SCHEMATIC

5.0 <u>INSURANCE APPLICATIONS</u>

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0. In the 1-percent-annual-chance floodplains that were studied by detailed methods, selected whole-foot BFEs or average depths are shown. Insurance agents use zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Kent County. Historical data relating to the maps prepared for each community are presented in Table 13, “Community Map History.”

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Bowers, Town of	August 9, 1974	None	July 2, 1980	September 2, 1982 May 5, 2003 July 7, 2014
Camden, Town of	May 24, 1974	December 12, 1975	September 16, 1981	May 5, 2003 July 7, 2014
Cheswold, Town of	August 9, 1974	None	January 7, 1977	May 5, 2003 July 7, 2014
Clayton, Town of	May 17, 1974	October 24, 1975	June 1, 1977	May 5, 2003
Dover, City of	May 31, 1974	July 22, 1977 January 2, 1976	September 16, 1982	May 5, 2003 July 7, 2014
*Farmington, Town of	May 5, 2003	None	May 5, 2003	
Felton, Town of	August 9, 1974	December 12, 1975	January 7, 1977	May 5, 2003 July 7, 2014
Frederica, Town of	May 17, 1974	December 26, 1975	January 2, 1981	May 5, 2003 July 7, 2014
Harrington, City of	May 17, 1974	December 19, 1975	June 1, 1977	May 5, 2003 July 7, 2014
*Hartly, Town of	May 5, 2003	None	May 5, 2003	
*Houston, Town of	May 5, 2003	None	May 5, 2003	

*No Special Flood Hazard Areas Identified

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Kent County (Unincorporated Areas)	June 27, 1975	None	March 15, 1978	March 2, 1983
				October 1, 1983
				April 2, 1992
				May 5, 2003
				July 7, 2014
*Kenton, Town of	May 5, 2003	None	May 5, 2003	
Leipsic, Town of	August 9, 1974	January 9, 1976	September 29, 1978	May 5, 2003
				July 7, 2014
Little Creek, Town of	August 9, 1974	December 12, 1975	January 17, 1979	August 3, 1992
				May 5, 2003
				July 7, 2014
*Magnolia, Town of	May 5, 2003	None	May 5, 2003	July 7, 2014
Smyrna, Town of	May 10, 1974	September 26, 1975	June 1, 1977	March 10, 1978
		January 9, 1976		January 15, 1982
				May 5, 2003
				July 7, 2014
*Viola, Town of	May 5, 2003	None	May 5, 2003	July 7, 2014
Woodside, Town of	May 5, 2003	None	May 5, 2003	July 7, 2014
Wyoming, Town of	May 24,1974	December 26, 1975	March 16, 1981	May 5, 2003
				July 7, 2014

*No Special Flood Hazard Areas Identified

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Kent County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, and FIRMs for all of the incorporated and unincorporated jurisdictions within Kent County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, One Independence Mall, Sixth Floor, 615 Chestnut Street, Philadelphia, Pennsylvania 19106-4404.

9.0 BIBLIOGRAPHY AND REFERENCES

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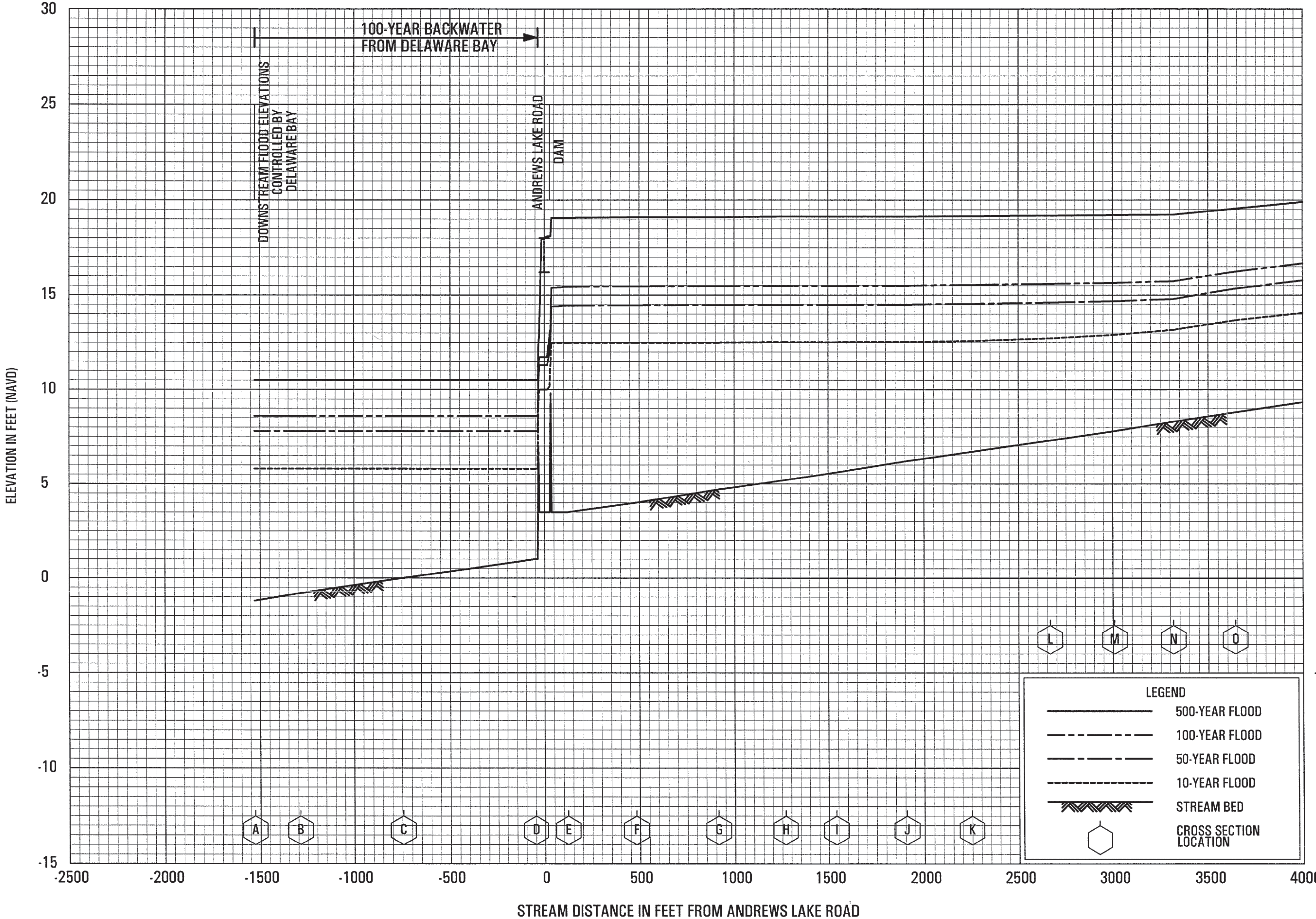


FLOOD PROFILES

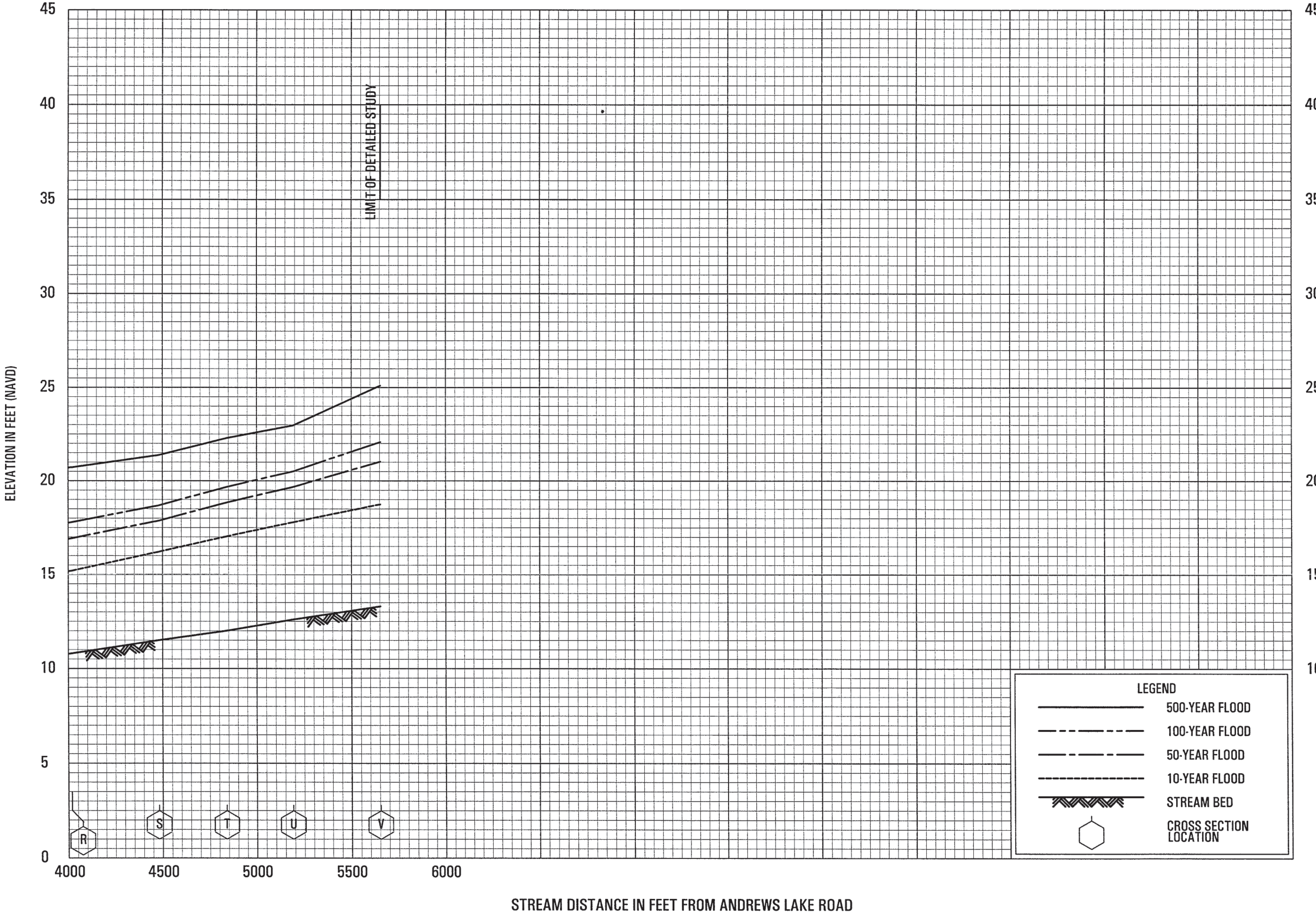
ANDREWS LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

01P



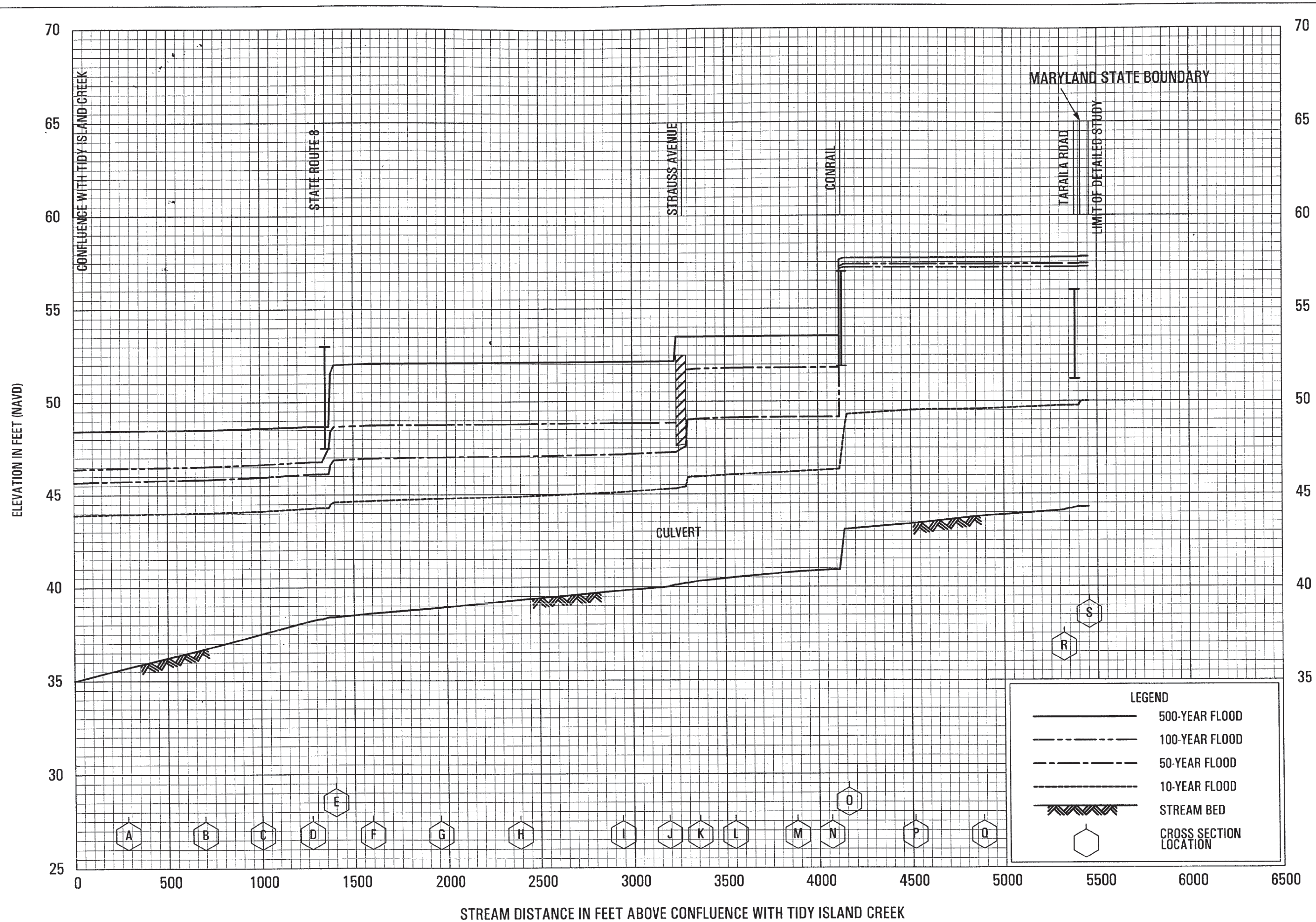
FLOOD PROFILES

ANDREWS LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

02P



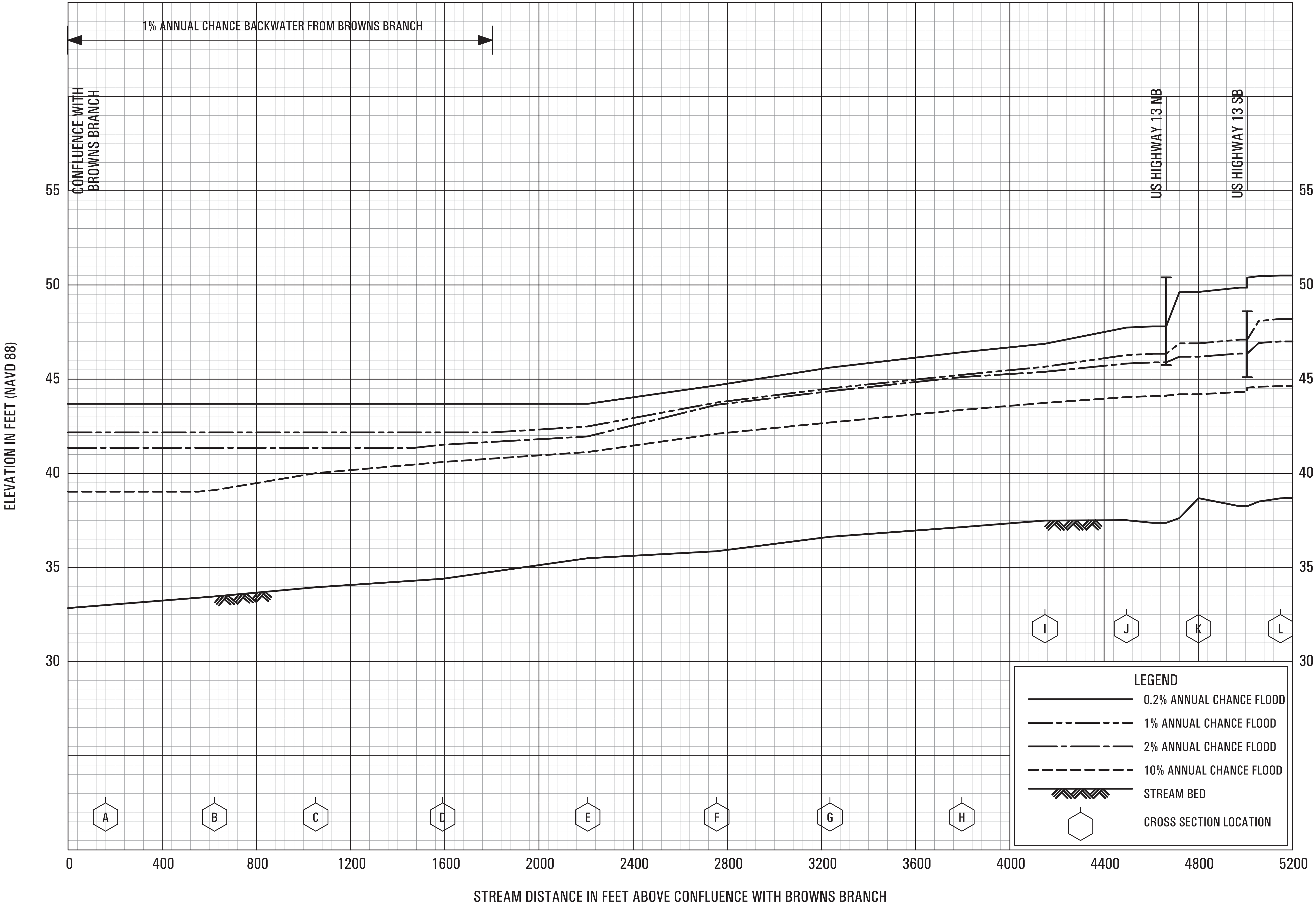
FLOOD PROFILES

BEAVERDAM DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE
AND INCORPORATED AREAS

03P



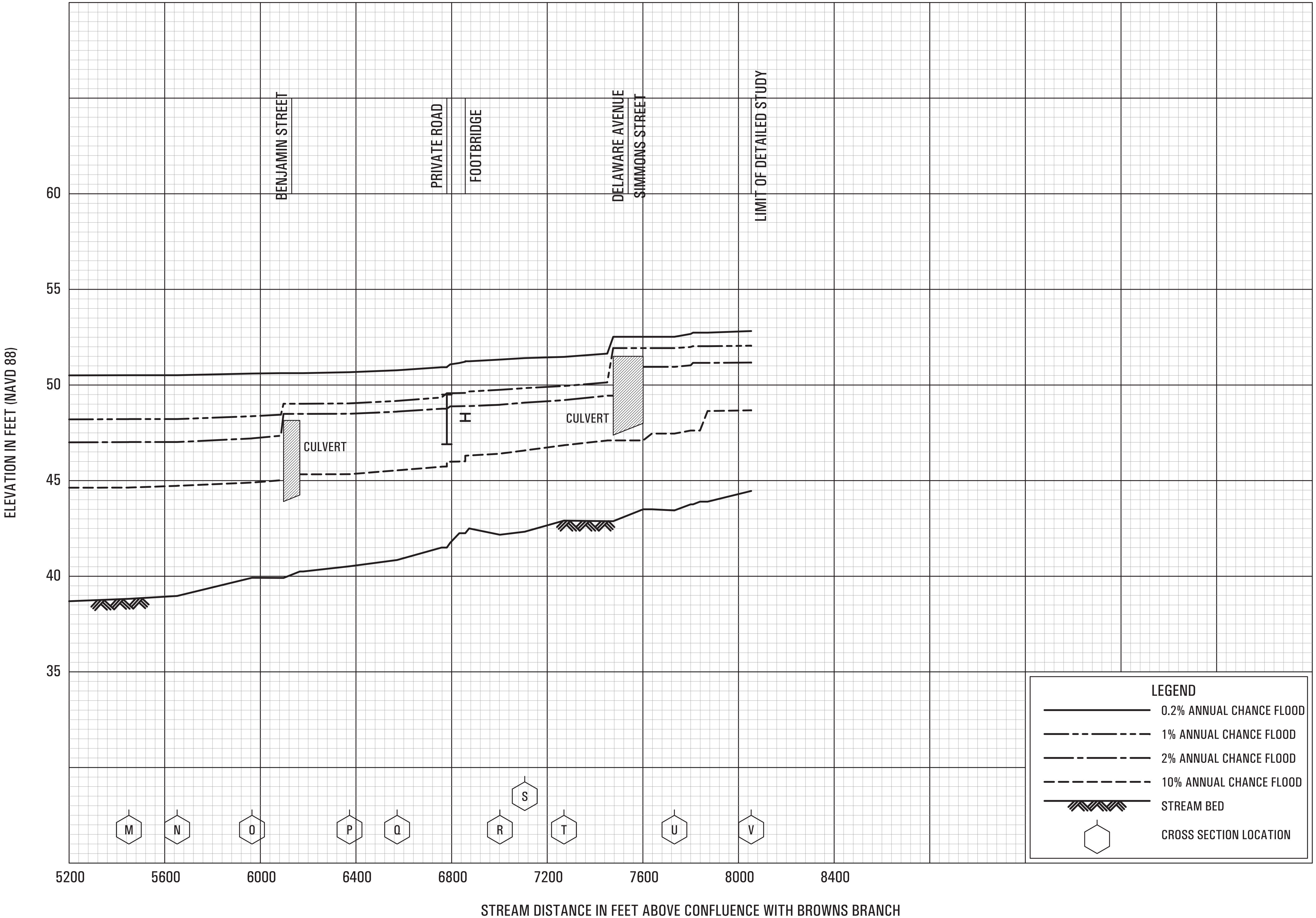
FLOOD PROFILES

BROWNS BRANCH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS



FLOOD PROFILES

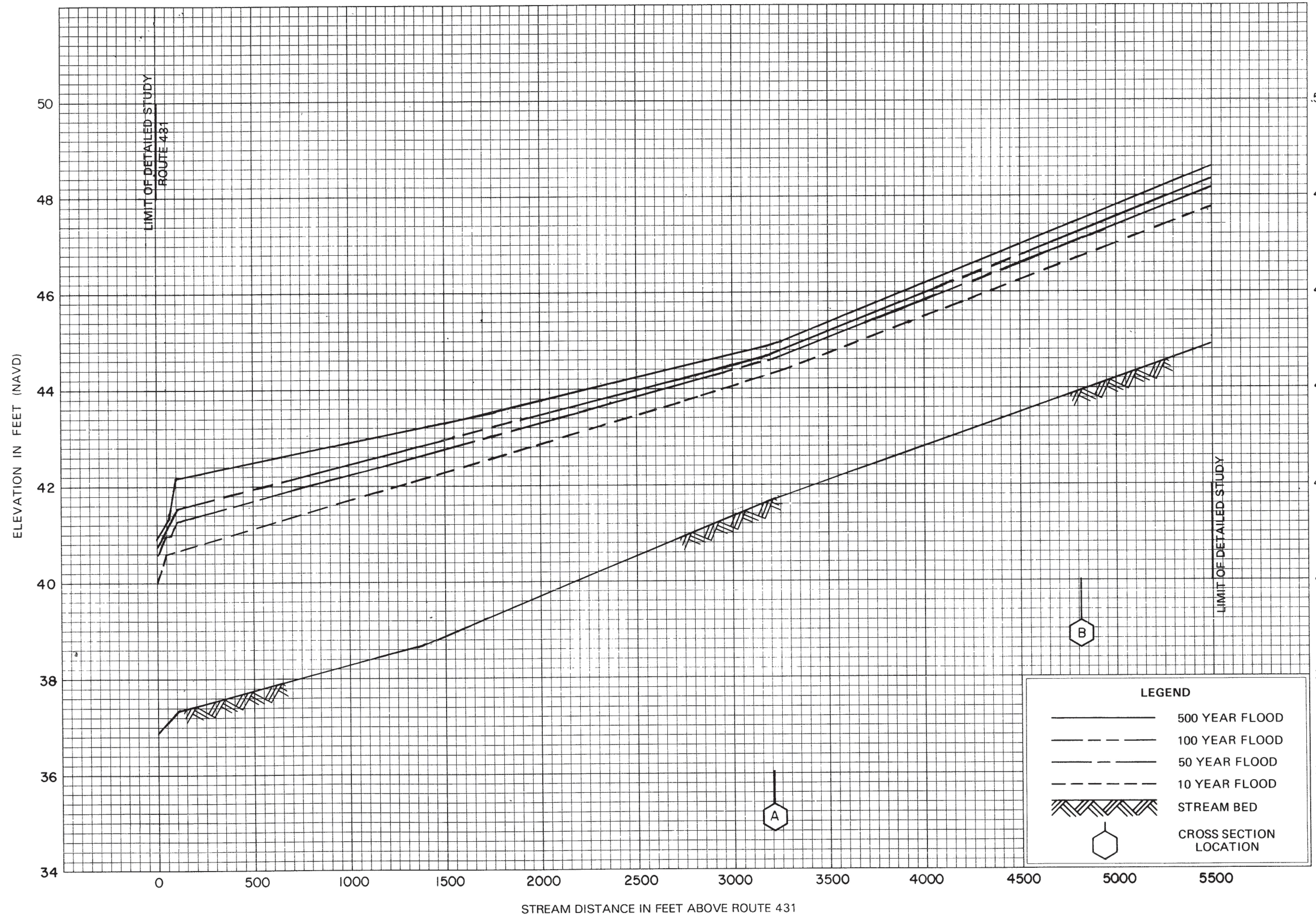
BROWNS BRANCH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

04P(b)



FLOOD PROFILES

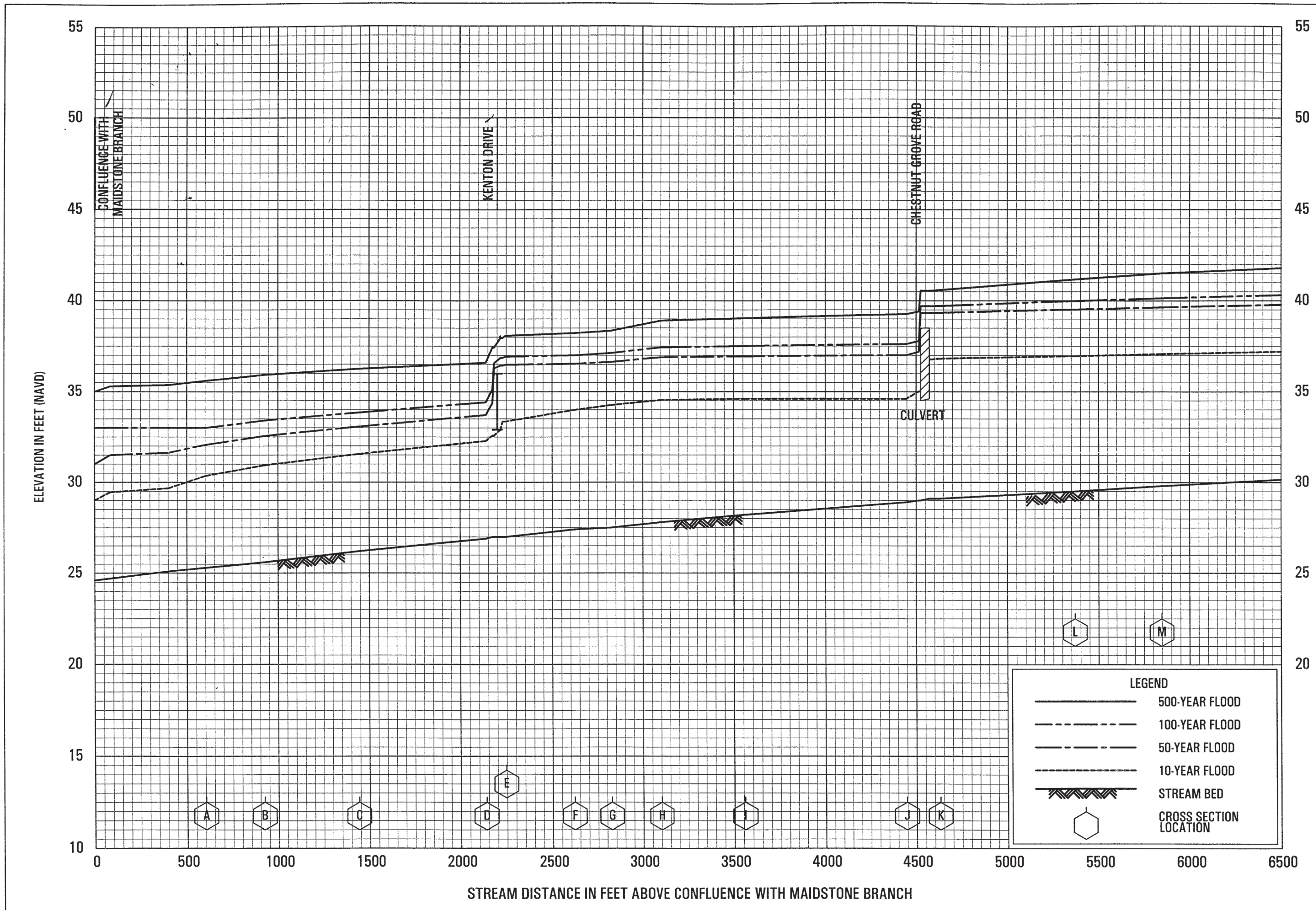
BROWN'S BRANCH SOUTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

05P



FLOOD PROFILES

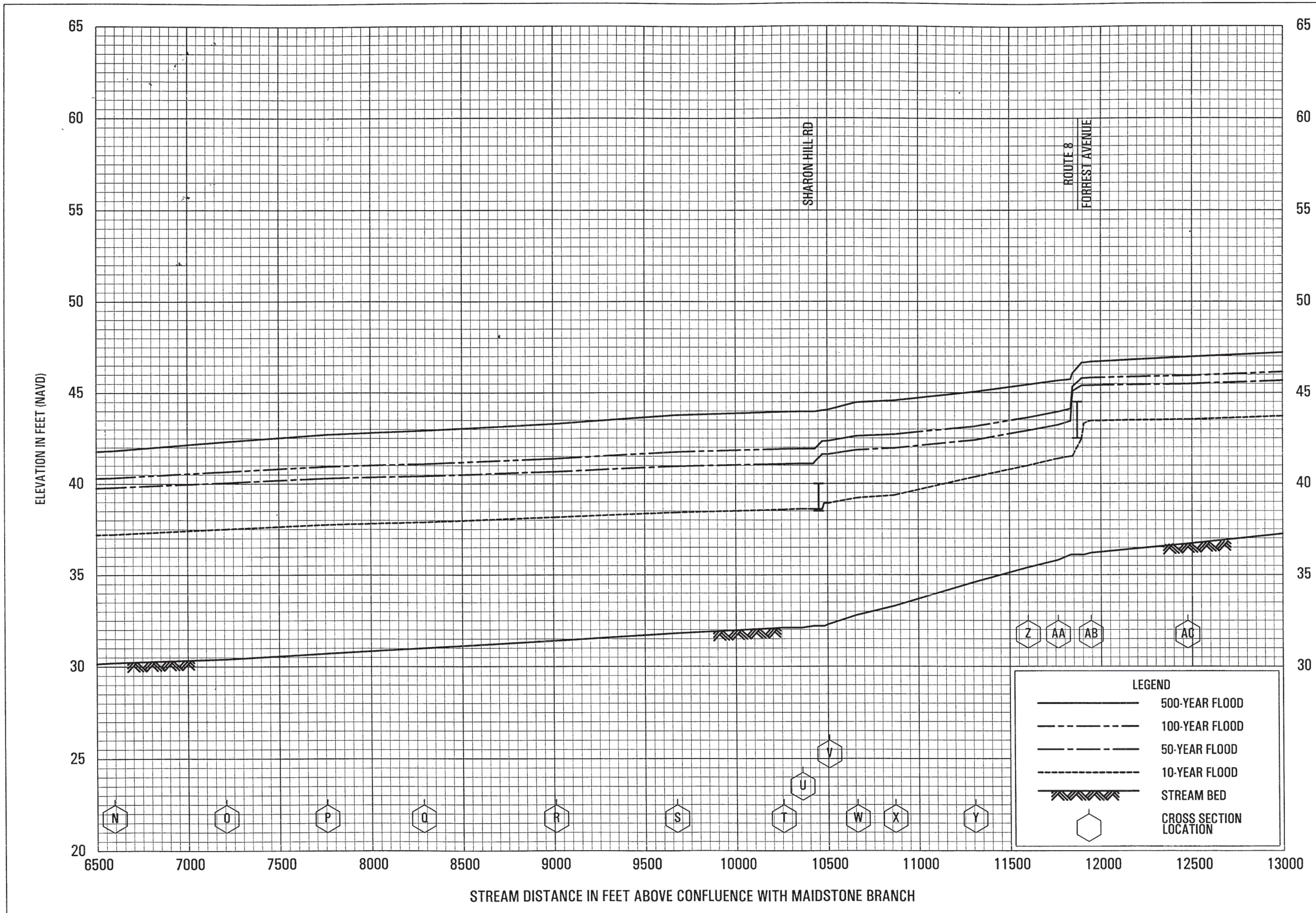
CAHOON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

06P



FLOOD PROFILES

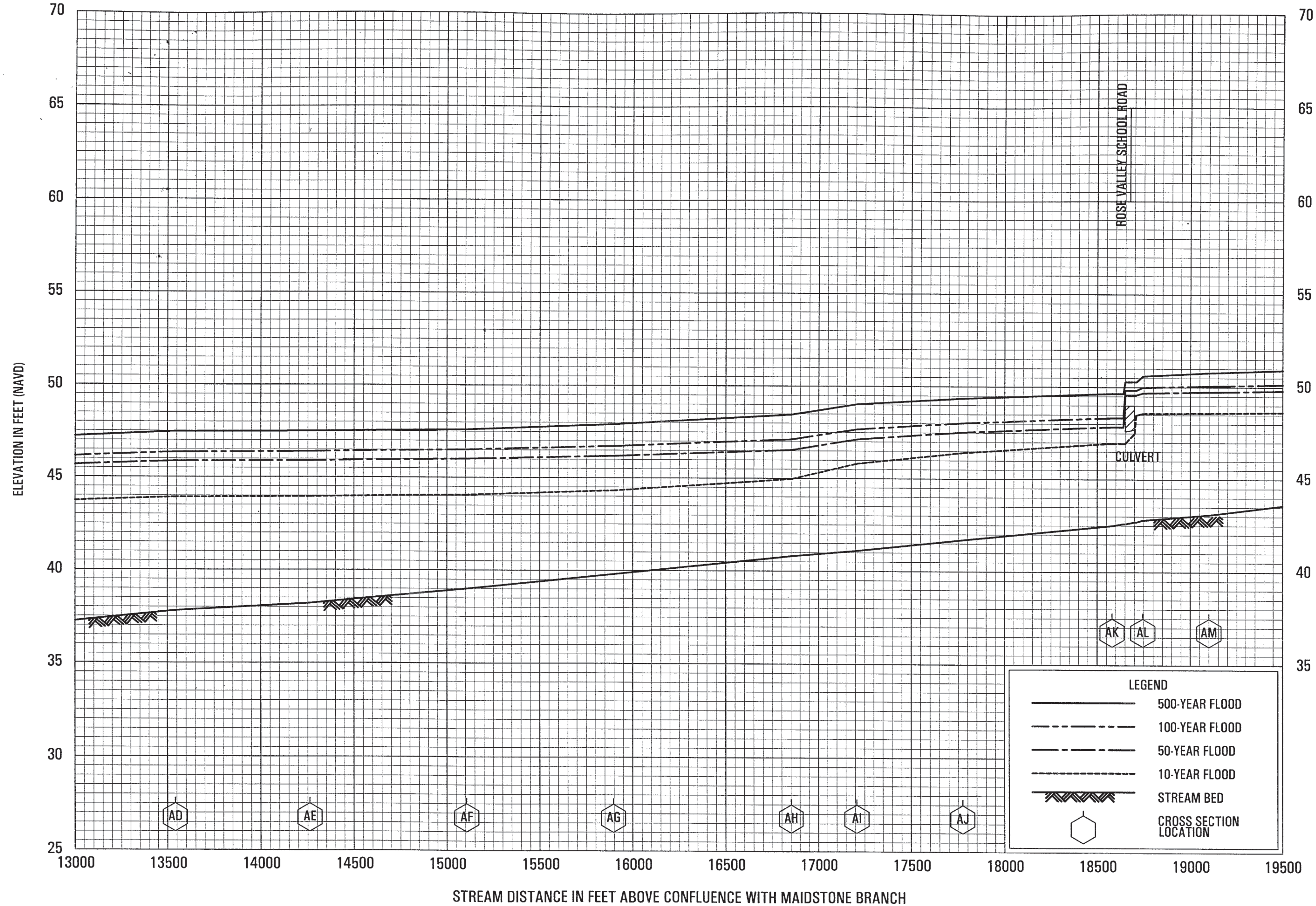
CAHOON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

07P



FLOOD PROFILES

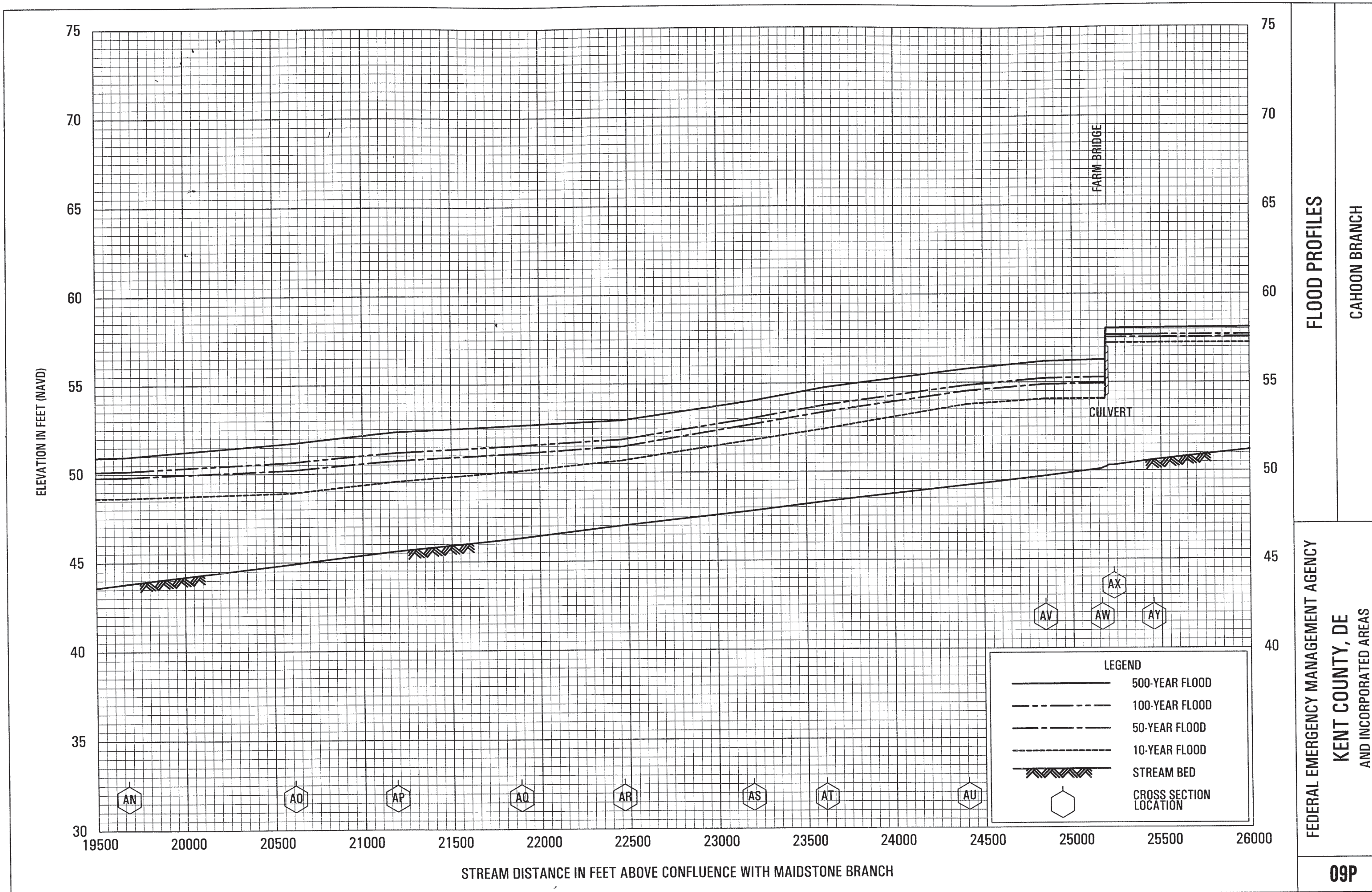
CAHOON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

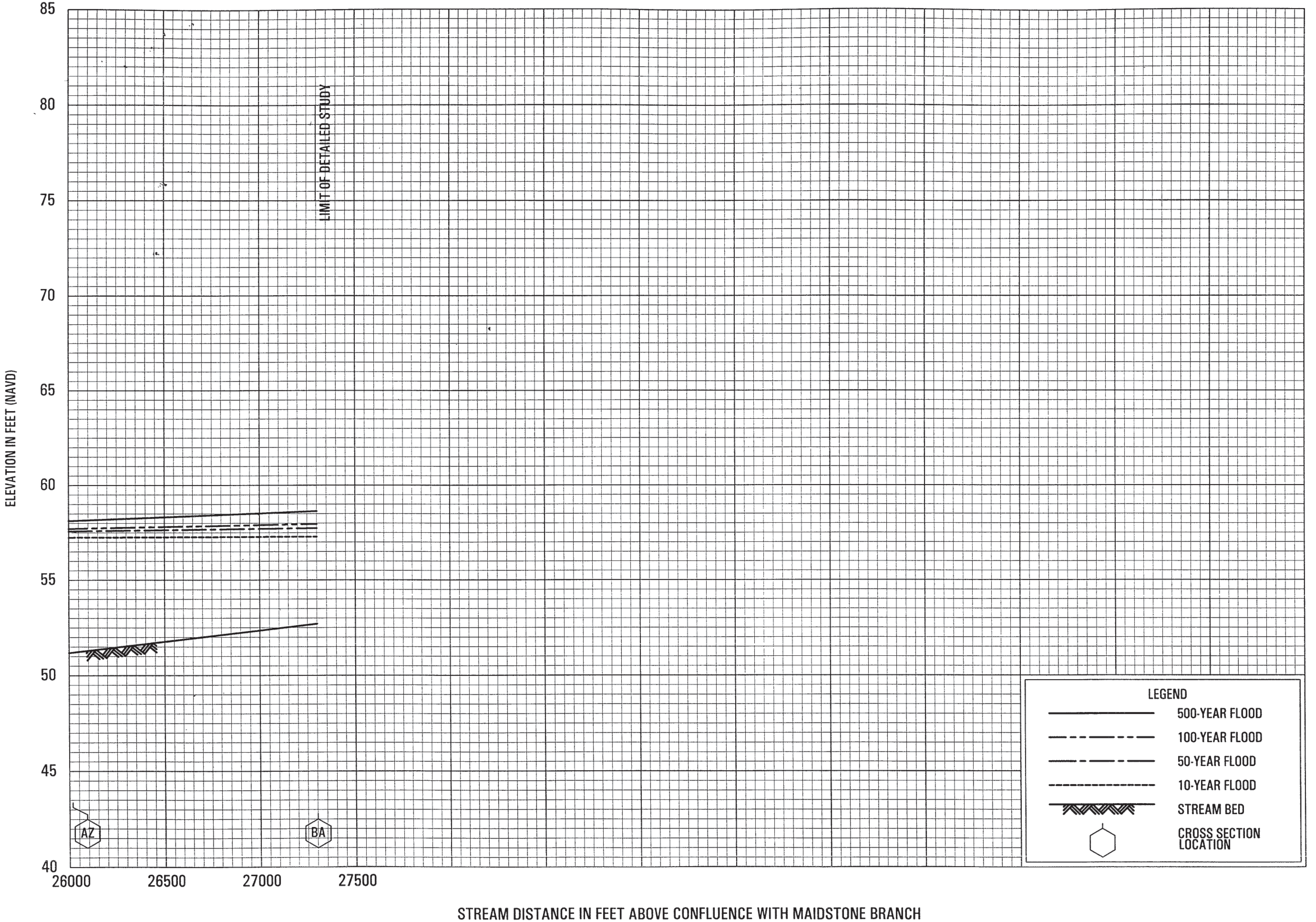
KENT COUNTY, DE

AND INCORPORATED AREAS

08P



ELEVATION IN FEET (NAVD)
75
70
65
60
55
50
45
40
35
30
FARM BRIDGE
CULVERT
AN
AO
AP
AQ
AR
AS
AT
AU
AV
AW
AX
AY
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
19500
20000
20500
21000
21500
22000
22500
23000
23500
24000
24500
25000
25500
26000
STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH MAIDSTONE BRANCH
FLOOD PROFILES
CAHOON BRANCH
FEDERAL EMERGENCY MANAGEMENT AGENCY
KENT COUNTY, DE
AND INCORPORATED AREAS
09P



FLOOD PROFILES

CAHOON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KENT COUNTY, DE

AND INCORPORATED AREAS

10P